DOCUMENT RESUME

ED 086 835 CE 000 867

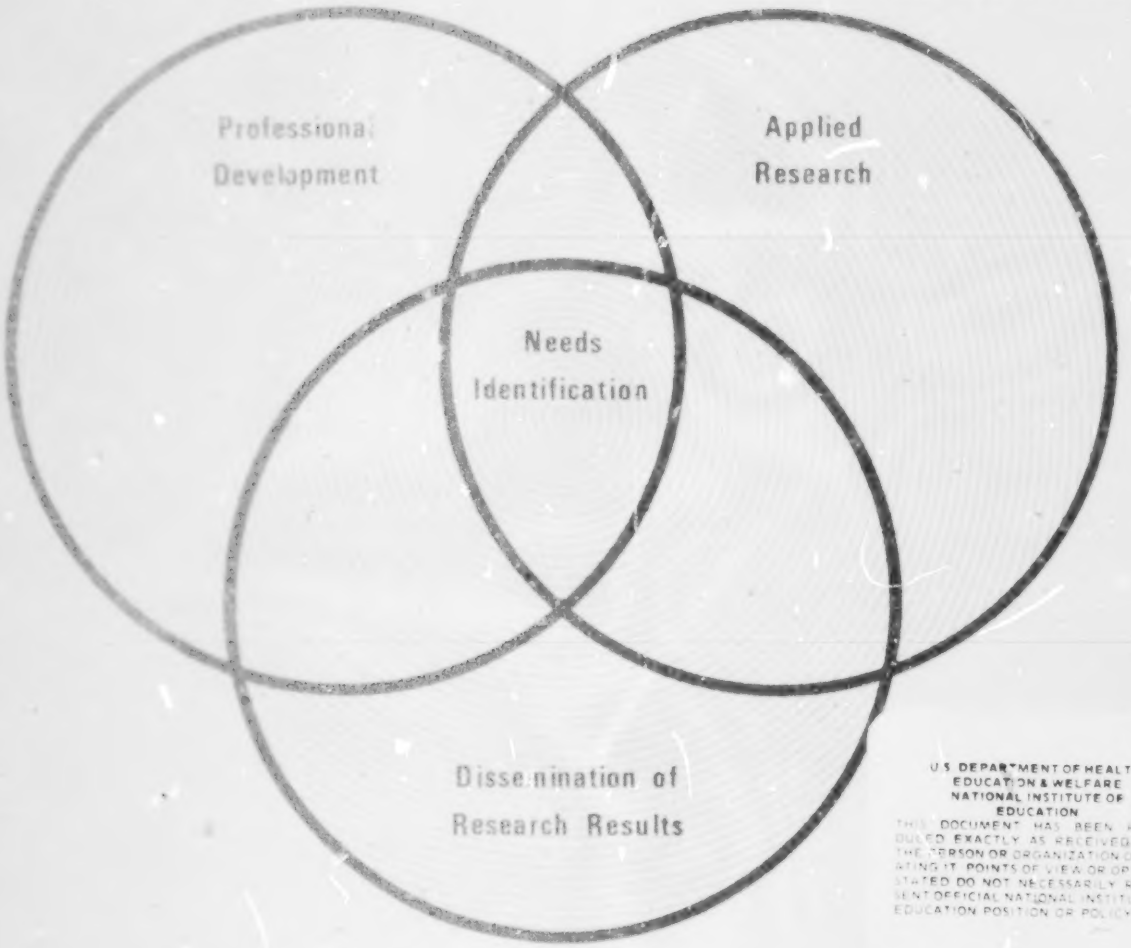
AUTHOR	Banks, John C.
TITLE	An Investigation of the Interaction of Learning Styles and Types of Learning Experiences in Vocational-Technical Education. Final Report.
INSTITUTION	Wisconsin Univ. - Stout, Menomonie. Center for Vocational, Technical and Adult Education.
SPONS AGENCY	Wisconsin State Board of Vocational, Technical, and Adult Education, Sheboygan.
PUB DATE	Jun 73
NOTE	185p.; For related document, CE 000 868; This document contains 151 leaves, some of which are tables, 11 inches wide by 8 inches high, and require two microfiche frames
EDRS PRICE	MF-$0.65 HC-$6.58
DESCRIPTORS	*Educational Research; *Learning Characteristics; *Learning Processes; Semantic Differential; Skill Development; *Student Attitudes; Technical Education; Vocational Education
IDENTIFIERS	*Learning Styles; Likert Type Scale

ABSTRACT

The document describes a sub-proposal which became a part of the Fox Valley Technical Institute's attempt to identify learning styles and their relationship to learning experiences in vocational-technical education. The sub-proposal consisted of the identification of a sub-set of learning styles and a determination of their relationship with the acquisition of technical skills and knowledges. It was initiated at the University of Wisconsin-Stout. Two learning style continuums were identified: concrete/symbolic and structured/unstructured. They were measured using a semantic differential and a Likert type scale (Learning Activities Questionnaire). After refinement, the use of the semantic differential was discontinued, and the scale was readministered to a group of 140 students from both the Institute and the Stout campus. The data gathered from that administration indicated all eleven vocational and technical education groups of students measured viewed themselves as emphasizing a concrete strategy which allows the learner to become personally and actively involved with an object. The two art groups preferred an unstructured learning style, while the other nine groups preferred a more structured style. It was concluded that the instruments could detect and measure differences in learning styles. (The questionnaire and tables of supportive data are included.) (AG)

ED 086835

BEST COPY AVAILABLE



U.S. DEPARTMENT OF HEALTH EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

CVTAE CVTAE CVTAE CVTAE

Center For Vocational, Technical And Adult Education UW-Stout Menomonie, Wisc. (54751)

CE000567

ED086895

FINAL REPORT

Sub-project to Fox Valley Technical Institute (VTAE District 12)
for Project No. 12-031-151-223

Conducted by

John C. Banks

CENTER FOR VOCATIONAL, TECHNICAL AND ADULT EDUCATION
UNIVERSITY OF WISCONSIN-STOUT
Menomonie, Wisconsin

June, 1973

AN INVESTIGATION OF THE INTERACTION OF LEARNING STYLES AND TYPES OF LEARNING EXPERIENCES IN VOCATIONAL-TECHNICAL EDUCATION

Table of Contents

Page

List of Tables ii

Acknowledgements iii

Chapter 1: The Interaction of Learning Styles and Types:

Problem and Objectives I-1

Summary I-1

Introduction I-3

Problem I-3

Objectives I-3

Rationale I-4

Learning Styles I-4

Learning Styles Dimensions I-7

Resume' I-14

Definitions I-16

Learning Style I-16

Concrete Style I-16

Symbolic Style I-16

Structured Style I-16

Unstructured Style I-16

Limitations of the Study I-16

Chapter II: Research Methods II-1

Introduction II-1

Validity II-1

Instrument Design and Scoring II-1

Pilot Administration II-4

Table of Contents Cont.

Pilot Instrument Reliability II-5

Final Test Administration II-6

Final Instrument Reliability II-7

Chapter III: Survey Results III-1

Pilot Instrument Design III-1

Pilot Groups III-2

Results III-2

Concrete/Symbolic Instrument Analysis III-2

Structured/Unstructured Instrument Analysis III-7

Final Instrument Design III-13

Results III-20

Concrete/Symbolic Instrument Analysis III-20

Frequency Distribution III-21

Group Comparisons III-25

Structured/Unstructured Instrument Analysis III-28

Frequency Distribution III-28

Group Comparisons III-30

Plottings III-37

Computer Program Development III-52

Learning Styles and Class Performance III-52

Summary III-53

Conclusions III-53

Chapter IV: Recommendations IV-1

List of Figures

		Page
I-1	Matrix	I-15
III-1	Pilot Administration Comparison of Individual Groups on the Concrete/Symbolic Learning Style Dimension . . .	III-1
III-2	Pilot Administration Comparison of Individual Groups on the Structured/Unstructured Learning Style Dimension	III-11
III-3	Pilot Administration Child Care Group I	III-14
III-4	Pilot Administration Child Care Group II	III-15
III-5	Pilot Administration Child Care Group III	III-16
III-6	Pilot Administration Audio-Visual Tutorial Typing . .	III-17
III-7	Pilot Administration Accounting II	III-18
III-8	Pilot Administration Automobile Technology	III-19
III-9	Comparison of Art Groups on the Concrete/Symbolic Learning Style Dimension	III-26
III-10	Comparison of Individual Groups on the Concrete/ Symbolic Learning Style Dimension	III-27
III-11	Comparison of Art Groups on the Structured/ Unstructured Learning Style Dimension	III-34
III-12	Comparison of Individual Groups on the Structured/ Unstructured Learning Style Dimension	III-35
III-13	Final Administration Drawing 500 Group Plot	III-40
III-14	Final Administration Life Drawing Group Plot	III-41
III-15	Final Administration Psychology Group Plot	III-42
III-16	Final Administration Machine Tool IV Group Plot . . .	III-43
III-17	Final Administration Machine Shop II Group Plot . . .	III-44

List of Figures cont.

III-18 Final Administration Mechanical Design IV Group Plot .III-45

III-19 Final Administration Mechanical Design II Group Plot III-46

III-20 Final Administration Industrial Drafting II Group Plot III-47

III-21 Final Administration Auto Body IV Group Plot III-48

III-22 Final Administration Electronics Technology IV Group Plot III-49

III-23 Final Administration Conservation IV Group Plot . . III-50

III-24 Final Administration Total Group Plot III-51

List of Tables

		Page
II-1	Content Validity of Instruments	II-2
II-2	Pilot Administration Reliability Coefficients for Each Learning Style Dimension for the Groups Tested . .	II-5
II-3	Correlation Between Likert and Semantic Differential Scores	II-7
II-4	Reliability Coefficients for Each Learning Style Dimension for the Groups Tested	II-8
III-1	Pilot Administration Item Analysis Concrete/Symbolic Learning Style Continuum	III-3
III-2	Pilot Administration Total Group Frequency Distribution Concrete/Symbolic Learning Style Continuum	III-5
III-3	Pilot Administration Item Analysis Structured/ Unstructured Learning Style Continuum	III-8
III-4	Pilot Administration Frequency Distribution Structured/Unstructured Learning Style Continuum . .	III-10
III-5	Pilot Administration Group Mean and Standard Deviation Comparison for Each Learning Style Dimension for the Groups Tested	III-12
III-6	Final Instrument Administration Total Group Item Analysis Concrete/Symbolic Learning Style Continuum	III-22
III-7	Final Instrument Administration Art Group Frequency Distribution Concrete/Symbolic Learning Style Continuum	III-23
III-8	Final Instrument Administration Total Group Frequency Distribution Concrete/Symbolic Learning Style Continuum	III-2

List of Tables cont.

III-9 Final Instrument Administration Total Group Item Analysis Structured/Unstructured Learning Style Continuum III-29

III-10 Final Instrument Administration Art Group Frequency Distribution Structured/Unstructured Learning Style Continuum III-31

III-11 Final Instrument Administration Total Group Frequency Distribution Structured/Unstructured Learning Style Continuum III-32

III-12 Group Mean and Standard Deviation Comparison for Each Learning Style Dimension for the Groups Tested III-36

III-13 T-test on Means for the Concrete/Symbolic Continuum III-38

III-14 T-test Means for the Structured/Unstructured Continuum III-39

III-15 Relationship Between Class Performance and Learning Styles III-52

Acknowledgements

The director of this project would like to express his sincere appreciation to Dr. Orville W. Nelson for his concern, guidance, understanding and patience; and Dr. Harold Halfin and Dr. Neal Prichard for their assistance during the preparation of this report.

Naturally many other individuals have participated at various times in the completion of the study by giving freely of their time and effort. My appreciation is extended to individual students who completed the pilot and final instrument; to teachers who allowed the director access to the students; Dr. Urban Oen and members of the Fox Valley Technical Institute staff for arranging and assisting in instrument administrations.

Members of the Center for Vocational, Technical and Adult Education staff at the Universtiy of Wisconsin - Stout who assisted throughout the study are to be commended for their effort.

Thank you.

J.C.B.

CHAPTER I

BEST COPY AVAILABLE

THE INTERACTION OF LEARNING STYLES AND TYPES: PROBLEM AND OBJECTIVES

Summary

This project was jointly proposed and submitted by Fox Valley Technical Institute, District 12, and the Center for Vocational, Technical and Adult Education at the University of Wisconsin - Stout to the Wisconsin Board of Vocational, Technical and Adult Education. The project was undertaken to investigate the interaction of learning styles and types of learning experiences provided to students in vocational-technical education.

During the past few years Fox Valley Technical Institute has been engaged in a number of curriculum modifications whereby the instructional materials for a number of different programs were reorganized into individualized experiences. An investigation of learning styles was undertaken to provide supportive data to improve learning systems, especially as those systems relate to individualized instruction.

In June of 1972 the original project was funded by the Wisconsin Board of Vocational, Technical and Adult Education. In the fall of 1972 the University of Wisconsin - Stout submitted a sub-proposal to the Fox Valley Technical Institute to identify a sub-set of learning styles and to determine their relationshilp with the acquisition of technical skills and knowledges.

This project identified a sub-set of learning styles which appeared to be most applicable to vocational-technical programs. These styles were further refined by developing a working definition and development of a matrix for each learning style sub-set.

This development formed the basis for the formulation of a learning styles attitudinal survey. A random sample of students enrolled at Fox Valley Technical Institute and the University of Wisconsin - Stout completed this instrument to provide data on the relationship between their tested learning style and the program of studies in which they were currently engaged.

This study specifically identified two learning style continuums relevant to vocational and technical education programs. These two continuums were labeled as (1) concrete/symbolic and (2) structured/unstructured. To measure these continuums two instruments were originally developed, a semantic differential and a Likert scale. The pilot instruments were administered at the Fox Valley Technical Institute. Based on data gathered from the instruments, an individual was placed somewhere along each of the continuums. The relative position on a continuum determined the extent the individual was influenced by a particular learning style. An individual who located near the continuum midpoint

would be affected by a composite of the continuum learning styles. A position near a continuum end was determined to show the individual as being highly affected by that style. (Examples of pilot instruments are found in Appendixes A and B.)

Data gathered at the pilot administration were used to revise the test, to improve reliability, to improve the clarity of the instrument and to determine concurrent validity of the dimensions investigated. The semantic differential instrument was discontinued and revisions were made in the Likert scale. The Likert scale was reproduced and arrangements were made to readminister the instrument.

The revised Likert scale, called a Learning Activities Questionnaire (Appendix C) was readministered to a group of students at Fox Valley Technical Institute and to a group of students on the University of Wisconsin - Stout campus. Data gathered and compiled from this administration form the basis for this report.

The study indicates:

a. the final instrument can effectively determine an individual's learning style based on the variables investigated in the study.

b. students tend to enroll in programs of study that match or complement their particular style of learning.

c. students viewed themselves as functioning effectively in a learning strategy that reflected a mix or composite of structured/unstructured learning styles.

d. students who participated in the instrument administration at Fox Valley Technical Institute tended to have concrete learning styles.

e. that analysis of data from instrument results will provide information on those individuals enrolled in a program displaying a learning style different from the group or different from the style necessary to effectively function in a program of studies.

f. to a teacher which individual students should be offered instruction in alternative modes of presentation. This determination is made by the individuals placement along the continuums investigated in the study.

g. that a classroom teacher can be provided with a simple, easily handled and easily scored instrument to effectively determine a student's learning style as investigated in the study.

h. that a teacher may use the instrument to make judgments about individual students when attempting to individualize and personalize a program, course or activity.

Introduction

During the last five to seven years, considerable attention has been given to individualizing instruction in all areas of the school curriculum. To date, most individualization has been based on time. The individual can move at his/her own pace, but must utilize and repeat the same learning experiences until he/she attains criterion performance. It is assumed that any child can learn skills or knowledges if just given enough time.

Even a brief review of the research done on learning suggests that various other variables influence the acquisition of knowledge, skills and attitudes. Thus, there is a growing need and concern to study the relevance of a number of learning and instructional variables to the individualization of learning experiences.

Problem

This study was concerned with the identification and investigation of a set of learning style variables and their relationship to the acquisition of technical skills and knowledges. In addition, this study will investigate the correlation between individuals' learning styles and their success or failure in their chosen program of studies. The study will also investigate the use of the computer to manage the presentation of instructional materials and provide feedback on the progress of the students.

Objectives

The objectives guiding this study were to:

1. Identify learning styles relevant to vocational and technical programs.

2. Select a sub-set of learning styles and develop the instrumentation required to measure them.

3. Develop a student reaction instrument to determine the degree to which students perceive that selected learning styles influence their acquisition of technical skills and knowledges.

4. Develop a matrix to visually depict the learning style continuums investigated.

5. Determine the degree to which learning styles correlate with a students' success in their chosen study program.

6. Initiate the design of a computer-based management system to process the information required to determine the type of learning experience appropriate for each student.

7. Provide the classroom teacher with an easily administered and easily scored learning styles attitude instrument giving them an opportunity to assess a student's style.

8. Provide a means of motivation to teachers and administrators to consider all variables of learning when assessing an individual.

Rationale

Learning Styles

Recent studies (Rosenberg, 1968; Dunn & Dunn, 1972; Tallmadge and Shearer, 1969; DeCecco, 1968) have mentioned that a child's learning style should be considered when developing an individualized program of studies. Individualizing instruction should focus the emphasis of the instructional process on each individual student - his skills, abilities, interests, learning styles, motivation, goals, etc. should all be assessed (Dunn & Dunn, 1972) when diagnosing learning activities for an individual.

Various learning characteristics have most often been studied with respect to content or difficulty of the level of instruction. In a report by Krogstad (1972) a large quantity of dependent and independent learning variables were isolated. He has suggested that learning style is an independent learner variable.

Numerous researchers have studied the area of learning styles and their effect on a student's ability to function in a learning situation. While conducting research in the area of learning styles the author found relevant studies included under the label of cognitive style, cognitive style mapping and learning styles.

Kagan, Moss and Sigel (1963, p. 74) defined cognitive style as a "term that refers to stable individual preferences in mode of perceptual organization and conceptual categorization of the external environment." In a recent study Davis (1971, p. 1447) stated that the term "relates to consistencies that individuals of various ages demonstrated in their functioning in a variety of tasks and situations." Both Kagan et al and Davis appear to be referring to the way an individual views his/her learning environment.

A study conducted by Satterly and Brimer (1971, p. 294) made reference to H. A. Witken's definition of cognitive styles as "manifestations in the cognitive sphere of still broader dimensions of personal functioning which cut across diverse psychological areas and represent different ways of cutting the personality pie from those traditionally used." Witkin's definition may indicate something other than cognitive learning. Shouksmith (1969) stresses the superordinate nature of the term and has employed it to refer to "the amalgam of the strategies a person employs in his approach to problems."

Frederick and Klausmeier (1970, p. 668) allude to differences in students' perceptions of situations around them. They state:

> ...teachers report that students perceive the same task differently, that some students comprehend situations better through discussion than by reading and independent study, that some are able to analyze and evaluate information readily in arriving at concepts and principles inductively and others are not. Thus, differences among students in styles of perceiving, cognizing, and conceptualizing are problably as real as are differences in general intellectual ability and educational achievements.

A study by Siegel and Siegel (1965) suggests that learners with certain cognitive styles are either facilitated or hampered by the particular teaching method to which they are exposed. The study further suggests that cognitive style not only operates to influence how well a student learns but also what kind of content the learner chooses to attend to and what content the learner would rather ignore or get out of the way as fast as possible.

Jerome Bruner deals with learning style in an indirect way. He does not specifically call it style, but appears to be aware of its existence along with related themes of learning. Bruner's early themes dealt with:

1. The role of structure in learning and how it may be made central to teaching.

2. Readiness for learning.

3. The nature of intuition - the training of hunches.

4. The desire to learn and how it may be stimulated. Interest in material to be learned is the best stimulus to learning (Bruner, 1961).

Later writings by Bruner (1966) suggested that the will to learn may become a problem. This may occur in situations where the curriculum is set, students are confined, and their path is fixed. This problem exists, not so much in learning itself, but in the fact that what the school imposes often fails to enlist the natural energies of the student. These energies include curiosity, a desire for competence, aspiration to emulate a model, and a deep sense of commitment to the need of social reciprocity.

Bruner is concerned that as each child develops he/she has certain characteristics of viewing the world and explaining it to himself. The task then is to teach a subject to a child, representing the structure of that subject, in terms of the child's way of viewing things. It is important in education to reflect not only the nature of the knower but also the knowledge getting process. Knowing is a process, and not a product (Bruner, 1966).

Bruner's statements lead one to believe that he is concerned about a child's learning style. He suggests that education should provide aids and dialogues for translating experience into the learner's way of attempting to solve a problem.

Along the lines of Bruner's theories, an awareness of learning style is evident in the Individually Prescribed Instruction programs. The Individually Prescribed Instruction program is based on the premise that children have a variety of learning styles. Some may need manipulative materials to work with while others may function well in small groups or benefit greatly from special projects. Others may need more practice on specific skills or opportunities to apply learned skills to new instructions (Scalon, 1972 and Byram and Larson, 1972).

If an individual's cognitive style can be determined Hill and Nunney (1971a, p. 38) suggested that it can then be mapped. They state that, "a student's cognitive style is determined by the way he takes note of his total surroundings - how he seeks meaning, how he becomes informed." A cognitive style map is composed of each individual, indicating if he is a listener or a reader? Is he concerned with only his viewpoint or is he influenced by others in making decisions? Does he reason like a mathematician or a social scientist? Each map would contain answers to questions like this plus information on a student's family background, talent, life experiences, and personal goals and aspirations; all of the things that make each individual unique. The map should identify ways "a student can master an educational task most readily, give him the self-knowledge essential to direct him to realistic career goals" (Hill and Nunney, 1971a, p. 38).

Research has dealt specifically with the term learning style. Taba, Levine, and Elzey (1964, p. 8) have defined learning style as the:

> modes of thought which an individual employs rather persistently in the variety of different cognitive tasks, such as: selecting a basis for grouping objects, determining how to label what he sees and how to organize the various aspects of his environment.

A publication by Rosenberg (1968, p. 22) states that "learning styles refer to an individual's characteristic pattern of behavior when confronted with a problem. If a person is observed in a number of different problem-solving situations, a modal pattern of behavior can usually be ascertained. It is this modal pattern of his behavior that he refers to as his style." DeCecco (1968, p. 75) suggests that learning styles are "personal ways in which individuals process information in the course of learning new concepts and principles."

Tallmadge and Shearer (1969, p. 222) have operationally defined learning style as "an attribute of an individual which interacts with instructional circumstances in such a way as to produce differential learning achievement as a function of these circumstances." Their investigation was concerned primarily with relationships existing between

learner characteristics and the method, rather than content, of instruction. A wide variety of individual difference measures were collected in the experimental students to enable identification of relevant learner characteristic variables.

Considering all facets of the research on cognitive style, mapping and learning style, an operational definition for learning style is suggested to be: consistent patterns of behavior or activity preferred and employed by the individual to effectively and efficiently acquire knowledge, skills and attitudes.

Learning style is a significant aspect of an individual's capacity to learn. Methods of evaluation should be developed to assess an individual's learning style. The present study was an attempt to develop evaluation techniques and to determine if there is a correlation between an evaluated learning style and a student's chosen field of study.

Learning Styles Dimensions

A definition of learning style is an all encompassing feature in any research dealing with the subject. Numerous researchers have isolated and defined various dimensions within the area of learning styles. Among these Rosenberg (1968, p. 33-61) identified four separate and interesting styles as being:

A. Rigid inhibited - a tightly closed system for processing information such that both intrapersonal and extrapersonal sources of information are supressed. This learner may exhibit the following behavioral characteristics:

1. Can not get the job done unless others are immediately available to him.
2. Oblivious to what is going on in the classroom.
3. Becomes confused and disorientated easily.
4. Misinterprets simple statements.
5. Gives answers which have nothing to do with the questions being asked.
6. Afraid to assert self or show initiative.
7. Shows signs of nervousness (nailbiting, crying, tics, rocking).
8. Generally unresponsive, hard to get to know.
9. Upset by change in routine.
10. Rigidly adheres to rules.

B. Undisciplined - this person tends to be overly sensitive to intrapersonal sources of information and has not learned how to effectively utilize extrapersonal sources of information. This learner may exhibit the following behavioral characteristics:

1. Negativistic - "I won't."
2. Acts defiantly, will not do what is asked.
3. Lacks tolerance for tasks they do not enjoy.

4. Tends toward temper tantrums and wild destruction.
5. Asserts independence in a negative manner.
6. Antisocial tendencies, (steals, lies, destroys property, bully, defies, resents discipline).
7. Speaks disrespectfully to teacher.
8. Prone to blame teachers for external circumstances when things don't go well.
9. Makes derogatory remarks about the subject being taught.
10. Breaks classroom rules, destructive.

C. Acceptance Anxious - this person tends to be overly sensitive to extrapersonal sources of information and has not learned how to effectively utilize intrapersonal sources of information. This learner may exhibit the following behavioral characteristics:

1. Tries too hard.
2. Wants to show off or impress others.
3. Overly sensitive to criticism or correction.
4. Worries about pleasing others.
5. Frequently seeks teacher contact and approval.
6. Excessively competitive and jealous.
7. Tries to out-do classmates by producing more quantity.
8. Outwardly nervous during tests.
9. Fearful of failure.
10. Friendly rather than distant in relationships with teacher.

D. Creative - this person has learned how to harmonize the utilization of both extrapersonal and intrapersonal sources of information such that maximum utilization can be made of both learning activities. The learner may exhibit the following behavioral characteristics:

1. Tells stories or describes things in an interesting fashion.
2. Is open to new ideas.
3. Shows persistence in attacking problems.
4. Thinks creatively in new situations.
5. Able to apply what he has learned to a new situation.
6. Constructively asserts himself.
7. Shows initiative in bringing things which relate to class work.
8. Is flexible.
9. Likely to know the material when called upon to recite in class.
10. Shows respect for teachers but can stand on his own two feet.

It is Rosenberg's belief that the style a person develops depends on two dimensions of his information - process ability: (1) locus of information and (2) level of symbolization. Locus of information involves the degree to which a learner is open to receiving information from two sources: information from within and from outside himself. Level of symbolication is the level of abstraction with which the learner is able to symbolically manage information in a problem-solving situation.

Within the four styles a continuum of adaptive to maladaptive behavior is postulated. Individuals may be using the same style, but one might be more effective in utilization than the other. Rosenberg hopes that utilization of his four styles in classifying students will enable the teacher to (a) anticipate how the student will relate intrapersonnally with peers and with authority and (b) anticipate how the student is likely to select, integrate, and act upon information presented to him in a learning situation (Rosenberg, 1968).

Rosenberg (1968, p. 21) comments further on the three components of diagnostic teaching as being:

1. The possession of a clear teaching objective and knowledge of steps necessary to reach this objective.
2. The ability of the teacher to thoroughly assess the individual differences that significantly influence the child's learning abilities. This involves an assessment of his specific learning skills and of his learning style.
3. That the teacher "harmonize" or "fuse" the curriculum with the unique competencies, needs and interests of each pupil.

In order to truly individualize the learning situation, one must assess all characteristics of an individual, be aware that different characteristics exist in all students, and be competent in making value judgments that affect learning based on these variables.

Bruner (1966, p. 44-45) alludes to three particular styles of learning. He states that:

> any problem within a domain of knowledge can be represented in three ways: by a set of actions appropriate for achieving a certain result (enactive representation); by a set of summary images or graphics that stand for a concept without defining it fully (iconic representation); and by a set of symbolic or logical propositions drawn from a symbolic system that is governed by rules or laws forming and transforming propositions (symbolic representations).

Oliver and Hornsby (1966, p. 68-69) offer some clarification to Bruner's three styles by stating:

> Enactive Representation - things should be seen as alike on the basis of a common role in some action (doing)
> Iconic Representation - might more likely be accomplished by grouping items according to perceptual kinships or likeness (sensing)
> Symbolic Representation - might well be expected to be covered by such grammatical principles as synonymy, superordination, or syntactic substitutability.

Bruner suggests possible situations to activate effective learning when dealing with these representations. A properly constructed

curriculum would provide for differences in children, different ways of sequencing learning, opportunities for some children to "skip" parts while others work their way through, and different ways of putting things (Bruner, 1966).

Hill and Nunney have established an elaborate coding system, in their program of Cognitive Style Mapping, at Oakland Community College in Michigan (Hill & Nunney, 1971b, p. 5). Their system includes four theoretical factors:

1. Theoretical Auditory Linguistic - the sound of a word.
2. Theoretical Auditory Quantitative - the sound of a number.
3. Theoretical Visual Linguistic - the written word.
4. Theoretical Visual Quantitative - the written number.

Their system includes 15 qualitative factors of which five deal with sensory stimuli:

1. Auditory - the ability to perceive meaning through the sense of hearing;
2. Olfactory - the ability to perceive meaning through the sense of smell;
3. Savory - the ability to perceive meaning by the sense of taste;
4. Tactile - the ability to perceive meaning by the sense of touch;
5. Visual - the ability to perceive meaning by the sense of sight;
6. Proprioceptive - sometimes referred to as the sixth sense, vehicle for conveying meanings associated with "programmatic effects;"
7. Code-empathetic - the ability to identify with or have vicarious experience of any other person's feelings, ideas, or volitions;
8. Code-esthetic - the ability of the individual under consideration to view with enjoyment the "beauty" and "pureness" of a resulting product, situation or idea;
9. Code-ethic - a commitment to a set of values, a group of moral principles, obligations and/or duties;
10. Code-histronic - staged behavior or a deliberate exhibition of emotion or temperment to produce some particular effect on other persons;
11. Code-Kinesics - the ability to communicate by means of non-linguistic functions such as blushing, and motions of the body such as shrugs, smiles, and gestures;
12. Code-Kinesthetics - motor skill abilities;
13. Code-proximics - the ability of an individual to judge the acceptable, critical, physical and social distance between himself and others as perceived by the other person;
14. Code-Synnoetics - personal knowledge of oneself in all qualitative and theoretical symbolic forms in relation to one's environment;
15. Code-transactional - the ability to maintain a positive communicative interaction which significantly influences the goals of persons involved in that interaction.

Three cultural determinants have been identified; family, individual and associates as having influence on the assorted and varied factors. The individual uses various forms of modalities of inference when dealing with these styles. Modalities of inference identified include; magnitude inference process, difference, relationship process, and appraisal inference.

Hill and Nunney (1971a) hypothesize that these assorted factors interact and intermix to produce a student's map. Each map, like each student, is different and is determined by the way he takes notice of things surrounding him - how he seeks meaning - how he becomes informed. By interviewing, testing and post-testing a map is determined for each student.

Witkin and his collegues (Witkin, Dyk, Faterson, Goodenough, and Karp, 1962) have developed a perceptual approach to the world in terms of an analytic-active/global-passive dimension. The analytic-active style individual is able to separate items from their irrelevant, embedding contexts.

A global-passive style individual reflects a vague, diffused, critical, experiential orientation to surroundings.

Osipow (1969) mentions some of the further work of Witkin and associates as dealing with field dependence and field independence. Field-dependent individuals choose popular occupations requiring considerable involvement with other people, and field-dependent students are low in achievement orientation. He further states that field-independent individuals appear cold and distant to others; and tend to be individualistic. Field-dependent individuals make favorable first impressions, are gregarious, affectionate, considerate and tactful.

Research that runs parallel to the work of Witkin and associates has been conducted by Kagan (1966). He states that individuals are often controlled by conceptual tempos; reflective/impulsive. Impulsive individuals select and report solution hypotheses quickly with minimal consideration for their probable accuracy. Reflective learners, of equal intelligence, take more time to decide about the validity of a problem solution. Kagan suggests that the teacher adjust his procedures and tempo of his teaching to accomodate both styles.

Kagan in association with Moss and Sigel (1960, 1963) and Coop and Sigel (1971) refers to three basic cognitive styles - descriptive, relational-contextual, and inferential-categorical which are based on children's and adult's performance on grouping and sorting tasks. The descriptive individual prefers to split the stimuli in his environment into parts and to attend these in units. They differentiate these units in the formation of categorizations. When the descriptive individual is required to group stimuli for purposes of categorization, they tend to base the groupings on an objective attribute shared by all of the stimuli. Any stimulus in the group is an independent instance of the categorization.

The relational-contextual classification is indicated by a preference for characterizing objects in the environment on the basis of a functional relationship that may exist among the objects. In this category no one stimulus can serve as an independent example of the concept; each stimulus must relate to other stimuli in order to be included as a member of the concept.

The inferential-categorical individual chooses to form his categorizations on the basis of inferences made about the stimuli that he groups together. No one attribute is singled out by the individual as basis of classification.

Cognitive interest styles related to vocational interests have been formulated by Holland (1966) and reported by Johansson (1971). The occupational world is represented by six cognitive styles: realistic, investigative, artistic, social, enterprising and conventional. Each of these six styles is composed of personal qualities that create predispositions for a particular class of vocations. The assumption is that a person enters a vocational field that fits his predisposition and cognitive style.

Johansson reports that the individual possessing the realistic style has such goals and values as avoiding abstract thought and reading; they prefer agricultural, technical and skilled trades, avoiding supervisory and leadership roles, they like activities that involve motor skills and achieve in technical areas. Occupations typical of this style would be machinist, skilled tradesman and farmers.

The investigative person prefers vocations of a scientific nature and avoids situations that require social skill and agressive interaction with others. They like activities involving asocial, analytic, and imaginative behavior. Problems are solved through the manipulation of ideas, words and symbols. Their achievement is apparent in academic and scientific areas and they tend to do poorly as a leader. Physical scientists and engineers would be most representative of this style.

The artistic individual prefers artistic, musical, literary, and dramatic vocations. They avoid direct relationships with others and avoid strenous activities but do enjoy creative and imaginative endeavors. Artists, interior decorators, musicians, photographers, actors and writers would be examples of this style.

The social individual prefers educational, religious and therapeutic vocations. They achieve in areas of leadership, culture and scholarship while avoiding roles requiring motor skills. The occupations of counselor, minister and social worker would fall into this category.

The person displaying an enterprising style can be a persuasive and powerful individual, with a preference for business roles and activities. They avoid confining activities requiring persistence but achieve in managerial and persuasive areas. Sales managers, salesman and buyers would be characterized in this area.

The conventional style person is one who prefers clerical and computational tasks that are rule orientated, avoiding aggressive outlets. They achieve in occupations of vocational status. This style is prevalent among bankers, business education teachers and accountants.

The assumption could be made that a person possessing certain characteristics of a particular style, according to Holland's theory, should engage in a suitable vocation in that particular style category. Failure of an individual to go into an area of matching styles might indicate a lack of understanding and assessment of the individual on the part of teachers, guidance personnel and administrators. Holland's vocational styles may be a dimension of the entire concept of learning styles.

Dunn and Dunn (1972) suggested that pupils are not presently diagnosed to determine the teaching strategies through which a youngster can learn best. They state that perceptual testing is rarely employed to identify whether a student is a visual, phonetic, tactile or kinesthetic learner. Children are rarely provided with the variety of media that would utilize the most effective learning style for each student.

They suggest that teachers and other members of the instructional team should analyze and determine each youngster's learning style. These are some of the "style" elements which should be checked:

1. Time
2. Schedule
3. Amount of Sound
4. Type of Sound
5. Type of Work Group
6. Amount of Pressure
7. Type of Pressure and Motivation
8. Place
9. Physical Environment and Conditions
10. Type of Assignments
11. Perceptual Strengths and Styles
12. Type of Structure and Evaluation

Guilford (1959) discusses variations to the styles discussed at this point. He states that there are four kinds of intelligence, two of them being called concrete/symbolic. Those abilities involving the use of figural information may be regarded as concrete intelligence. People who depend most upon these abilities deal with concrete things and their properties. Among these people are mechanics, operators of machines, engineers (in some aspects of their work), artists and musicians.

Symbolic abilities pertain to abstract intelligence. These abilities should be important in learning to recognize words, to spell, and to operate with numbers. Language and mathematics depend very much upon them, except that in some mathematical aspects, such as geometry, have strong figural involvement.

Resume'

Extensive research on learning styles has been conducted as detailed by the review of literature. The present study devotes half of its investigation to the learning style continuum of concrete/symbolic learning. The remaining half of the work will deal with the structured/unstructured learning style continuum. The review of literature dealt with many styles, the two continuums investigated appear relevant for vocational-technical education programs.

The matrix in Figure I-1 provides information on the various behavioral characteristics and instructional modes investigated in the study. The matrix illustrates the two continuums studied and provides the reader with insight and understandings in the area of learning styles. Ingredients, definitions and use of terms are often open for argument. Development of the matrix formed a basis for making judgments in the study and hopefully will provide the reader the necessary background to understand the guiding aspects followed in the study.

The two dimensions investigated are by no means all inclusive and in no way reflect the totality of the concept of learning styles. Many individuals have investigated learning styles. Investigations are currently being conducted and future investigation of the subject will be conducted. Past and present investigations have suggested that the concept of student assessment in this area is just beginning. As the interest in individualization of instruction increases, assessment of many possible variables influencing an individual's learning will need to be considered.

If assessment of an individual's style can be reliably determined, it is then conceivable that alternative modes of instruction or methods of presentation may be developed to provide the student an opportunity to learn material by a method that compliments his/her learning style. One must realize that learning style is one of the many possible variables that affect an individual's capacity to learn. True individualization of instruction will consider the many variables.

Lending support to the above statements Hester and Tagatz (1971, p. 237) feel that styles are an important dimension of individual differences in functioning. They state "if greater efficiency in concept attainment can be achieved, individuals will be able to experience greater success in and out of the classroom. An individual can be instructed in a manner consistant with his style."

Extensive research in the area of styles has been conducted by Tallmadge and Shearer (1969, 1971) especially as it relates to learner characteristics, types of learning, instructional methods, and subject variables. They ask some very serious questions relative to the effectiveness of all learning style research. But while questioning the effectiveness they further state, "it does not appear that learning style research should be abandoned." No attempt at abandoning the subject is intended in the present report.

Figure 1

MATRIX

Dimension	LEARNING STYLE Behavioral Activity Characteristics Representing the Style	INSTRUCTIONAL MODE
1.1-Concrete	1.1.1-Likes to deal with objects in "hands-on" activities 1.1.2-Deals directly with phenomena 1.1.3-Personal Involvement 1.1.4-Employs the use of tools, materials and equipment	1.1.1-Laboratory Activities 1.1.2-Experiments 1.1.3-Group Activity 1.1.4-Object Involvement (Project) 1.1.5-Mediated Tutorial
1.2-Symbolic	1.2.1-Prefers to deal with abstract representation of objects and phenomena to convey learning	1.2.1-Computations 1.2.2-Verbal Activity 1.2.3-Mediated Instruction 1.2.4-Language and Reading Activity
2.1-Structured	2.1.1-Prefers to participate in highly organized activities from simple to complex 2.1.2-Passive student involvement in planning and organizing student activities	2.1.1-Entire course sequence and content specified for student
2.2-Un-Structured	2.2.1-Prefers no definite pattern of classroom organization 2.2.2-Self pacing 2.2.3-Active student involvement in planning and organizing activities 2.2.4-Prefers to "plan" his own activities, usually not far in advance	2.2.1-Self-guided instruction 2.2.2-Student selection of content and objectives 2.2.3-Self-sequence with few guidelines

Definitions

Learning Style - Consistant patterns of behavior or activity preferred and employed by the individual to effectively and efficiently acquire knowledge, skills and attitudes.

Concrete Style - A preferred learning strategy employed by the individual where optimum learning is affected by that individual in a situation that allows the learner to become personally and actively involved with an object or in direct contact with phenomena in "hands on" experience.

Symbolic Style - A preferred learning strategy employed by the individual where optimum learning is affected by that individual in a situation that allows the learner to engage in a wide variety of mediated, computational, reading or verbal interaction to achieve learning.

Structured Style - A preferred learning strategy employed by the individual where optimum learning is affected by the learner in a highly organized situation. The sequence and form of instruction are determined prior to engaging in the learning activity.

Unstructured Style - A preferred learning stragety where optimum learning is affected by the learner in an unorganized situation. The student utilizes a random pattern of personal selection and involvement in learning activities and objectives and a specific sequence are avoided.

Limitations of the Study

A survey of related literature reveals that numerous individuals have done research on the subject of learning styles. It is evident that each individual has his own concept of what a learning style is and also his own idea of various styles that affect a student's learning capabilities. A limitation therefore of this study is that its scope was not broad enough to cover all possible ramifications of the subject of learning styles.

Again it must be reiterated that the two continuums chosen for investigation appeared relevant to the area of vocational, technical education.

Another possible limitation was the mood of the responders. The pilot and final administration were conducted at the Fox Valley Technical Institute. This school has extensively individualized its learning environment and students are concerned that this has lessened teacher-student interaction. Depending on how students perceived the instruments used in this study, there may be some question as to the motive with which the instrument in the study was completed.

Certain limitations appear in the instrument itself. Questions in relation to the concrete/symbolic dimension may not have been stated specifically enough. Evidence of the fact appears in the low reliability coefficients attained for the dimension. This may indicate that additional variables were functioning in the concrete/symbolic continuum.

The instrument designed was a Likert attitude opinionnaire and was administered in the students' classrooms. This atmosphere may influence an individual's response depending on his/her likes or dislikes for the instruction in that situation. This may place a limitation on the study depending on the teaching style the student was presently operating under and whether or not he/she was successful in that situation.

One instrument was developed and tested at the completion of the study. This may be a limitation because it was necessary for an individual to operate in a symbolic situation to complete the instrument. If their preferred learning style was not symbolic this may have some bearing on the validity of the responses to the present instrument.

CHAPTER II

RESEARCH METHODS

Introduction

An extensive review of literature, concerned with the subject of learning styles, was undertaken in order to supplement the writer's knowledge of the field. Readings were made primarily in current periodicals and professional journals as well as in books dealing with the subject. Consultations with appropriate resource people were undertaken throughout the study and advice was sought from the writer's advisor and incorporated into the study.

After the review of literature was completed, the development of an assortment of research instruments was undertaken. The final instrument to be designed was to provide input as to whether it was possible and practical to evalute an individual's learning style. It was anticipated by the writer that the instrument in its final form could be administered to vocational-technical students to effectively determine their particular learning style or styles.

The review of literature provided the writer with an awareness of other investigations concerned with the subject area of learning styles. A number of instruments were developed by the writer to measure learning styles as defined by several researchers. Various instruments were provided to the project director and it was decided to develop a semantic differential and a Likert attitude scale to measure the dimensions of concrete/symbolic and structured/unstructured learning styles. (See Appendixes A and B.)

Validity

The writer's understanding and awareness of the subject area formed a basis for determining validity. Based on the review of literature and development of a l arning styles matrix (Chapter I) a table of specifications was compiled to provide a content validity check and guidance during the instrumentation development process. Table II-1 provides information on those instrument items determined to measure characteristics of the two continuum styles. By administering both a semantic differential and a Likert scale at the same time during the pilot administration, a concurrent validity assessment could be made.

Instrument Design and Scoring

In designing the instruments the dimension of concrete to symbolic formed a continuum from highly concrete to highly symbolic. Statements on the instrument were developed to reflect various positions or levels between continuum ends. The dimension of structured to unstructured was developed in the same manner.

TABLE II-1

CONTENT VALIDITY OF INSTRUMENTS

Continuum Characteristics	Instrument Items		
	Pilot Administration		
	Likert	Semantic	Final Administration
Concrete			
1.1 Deals with objects in hands on activities.	1	1	1
1.2 Deals directly with phenomena.	2	2	2
	3	3	3
	4	4	4
1.3 Personal involvement.	5	5	5
			6
1.4 Employs the use of tools, materials and equipment.			
Symbolic			
1.2 Prefers to deal with abstract representation of objects and phenomena to convey learning.	6	6	7
	7	7	8
	8	8	9
	9	9	10
	10	10	11
Structured			
2.1 Participates in highly organized activities from simple to complex.	11	11	12
	12	12	13
	13	13	14
2.2 Passive student involvement in planning and organizing activities.	14	14	15
	15	15	16
Unstructured			
2.1 No definite pattern of classroom organization.			
2.2 Self-pacing.	16	16	17
	17	17	18
2.3 Active student involvement in planning and organizing activities.	18	18	19
	19	19	20
	20	20	21
			22
2.4 Prefers to "plan" own activities.			

On the pilot Likert scale five questions were designed to measure each of the four styles investigated in the study. The statements developed to measure the concrete and structured styles, statements 1-5 and 11-15 respectively, were awarded a positive valence. Statements that were to measure the symbolic and unstructured styles, statements 6-10 and 16-20 respectively, were awarded a negative valence. The valence was arbitrarily chosen to enable a raw score to be posted for each individual somewhere along each continuum.

On the Likert Pilot Instrument respondents were asked to react to the statement according to the following scale:

1 - Of No Value
2 - Somewhat Valuable
3 - Of Average Value
4 - Very Valuable
5 - Extremely Valuable

Positive valence items were scored using a value of 1 to 5. If the responder thought a concrete or structured item was extremely valuable to him in a learning situation that item was scored a value of 5. Conversely if the responder thought a symbolic or unstructured item was extremely valuable to him in a learning situation that item was scored a value of 1. Negative valence items were scored using a value of 5 to 1. This value provided a high concrete score of 50, providing the responder thought the concrete items were extremely valuable while stating that the symbolic items were of no value to him in a learning situation. Conversely the highly symbolic individual would score a low of 10 which would be the reverse of the concrete style. This applied to the structured/unstructured dimension too. The continuum had a value range of 10 to 50. The lower the raw score of the individual, or the closer the number appeared to 10 the more symbolic or unstructured the individual viewed himself in a learning situation. The larger or closer the number appeared to 50 the more concrete or structured the individual appeared in a learning situation. The continuum mid-point was determined to be 30. This is the point at which an individual could have responded to all 10 continuum items by stating they were of average value in a learning situation. The continuum midpoint could also be achieved by an assortment or mix of the response values. This may indicate that one is not directly influenced by any one style on a continuum or that he prefers a mix of styles.

The semantic differential was developed in a format similar to the Likert scale. Five statements were developed to measure the same four learning style dimensions. Each statement allowed for five responses and the value scale was between a low of one to a high of seven. (See Appendix A.)

Questions one to ten formed a continuum between concrete/symbolic with a low value of 50 appearing for highly symbolic to a high value of 350 appearing for highly concrete responses. The value was determined by assigning a valence to the adjectives appearing on the right side of the instrument. The valence for the concrete and structured items was as follows:

easy - positive
confusing - negative
meaningless - negative
interesting - positive
worthless - negative

The valence for symbolic and unstructured items were given an opposite value.

Positive items were thus scored on a scale of one to seven and negative valence items were scored on a value scale of seven to one. This was done to again provide two raw scores, one for each continuum. The higher or larger the raw score the more concrete or structured the individual, while the lower the raw score the more symbolic or unstructured the learner.

It was felt that designing the instrument so that a raw score could be established and placed along a continuum would be a benefit to a classroom teacher. The final instrument could be administered in the classroom and scored manually by the teacher to determine an individual's learning style based upon the research in this study.

Instruments were assembled and forwarded to Dr. Urban Oen at Fox Valley Technical Institute in Appleton, Wisconsin for his evaluation and suggestions. Some modifications in the instruments were made and both were duplicated and assembled. A date was arranged with Dr. Oen for the writer to administer both instruments to a selected group of students enrolled at Fox Valley Technical Institute in a pilot administration.

A weighed score analysis program was developed to provide data on the pilot administration of the instrument. (See Appendix D.) Hoyt's analysis of variance formula was used to compute instrument reliability.

Pilot Administration

A group of 98 students at Fox Valley Technical Institute participated in the pilot administration of the instruments. Arrangements to allow the writer to go into participating classes at the Institute were made by Dr. Oen and the teacher of the class. All students completed the semantic differential and Likert attitude instrument. Males and females enrolled in such diverse programs as child day care, audio-visual tutorial typing, accounting and automobile technology participated in the pilot administration.

It was determined by the writer and consultants that the above groups reflected characteristics specifically related to the learning style variables investigated. An hypothesis was made that individuals who chose a program of study did so because they had a compatable learning style with that program.

The pilot administration was conducted to determine the instruments effectiveness, obtain student reactions to the directions, assess ease of

understanding the statements and aid in determining if additional revisions needed to be made.

Based on the results of the pilot administration it was determined to discontinue the use of the semantic differential scale and to revise the Likert attitude scale. By comparing the data accumulated on both instruments it was determined that similar variables were being measured. Since the Likert was more efficient to use, it was selected for this study.

Revisions to the Likert instrument were made to improve reliability and to incorporate suggestions that participants offered during the pilot administration.

Pilot Instrument Reliability

Table II-2 provides information on the reliability coefficients attained as a result of the pilot administration of the Likert Instrument. Reliability figures for the semantic differential instrument were not compiled in this Table as the instrument served as a basis for determining concurrent validity. Reliability coefficients were determined by applying Hoyt's analysis of variance method.

TABLE II-2

PILOT ADMINISTRATION RELIABILITY COEFFICIENTS
FOR EACH LEARNING STYLE DIMENSION
FOR THE GROUPS TESTED

Group	Concrete/ Symbolic	Structured/ Unstructured
Child Care I	.52	.64
Child Care II	.15	.85
Child Care III	.25	.87
Audio-Visual Tutorial Typing	.00	.85
Accounting II	.00	.80
Automobile Technology	.49	.76
Instrument Reliability for Total Groups	.29	.80

As indicated by Table II-2, reliability coefficients for the concrete/symbolic learning style continuum appear very low. Actually a negative coefficient was attained for the tutorial typing and accounting groups. Child care group I and the automobile technology group provided reliabilities near the .50 level. The total test reliability for the concrete/symbolic continuum was .29, indicating that other variables may be functioning in this continuum or that the items are weakly constructed. The structured/unstructured learning style continuum attained a total test reliability of .80 which would indicate that it is a much more precise measuring device.

The low reliability coefficients attained on the concrete/symbolic continuum were somewhat discouraging. The total instrument was revised based on information provided by the responders in an oral evaluation session at the completion of the pilot administration and the computer printout. Based on these two sources, revisions in the instrument were conducted. It was thought reliability could be improved by changing some of the wording and by adding another statement to increase the length of the instrument.

Generally speaking the pilot administration was conducted smoothly and efficiently. All individuals were very positive about the administration and all suggestions were helpful.

Concurrent validity of the Likert scores was assessed by computing the Pearson correlation coefficient between the Likert and Semantic differential scores. Each individual in the pilot administration completed both instruments and their scores on each instrument were used to determine the correlation.

Students from three diverse programs, Child Care Group I, Accounting II and Auto Technology were selected to determine the validity of the Likert instruments. Table II-3 gives the correlations between the two instruments for the concrete/symbolic and structured/unstructured continuums. Zero correlation was established between both instruments in the Child Care Group I for both continuums. Significant correlation was established between variables in the Accounting II group in the two instruments and the Auto group provided a high positive correlation on the structured/unstructured variable. The correlation between concrete/symbolic for the Auto Technology students was positive but low.

For all groups combined, the concrete/symbolic continuum provided a correlation coefficient of .18 indicating a slight relationship between the two instruments. A reliability correlation of .33 was attained on the instruments for the structured/unstructured continuum indicating that a significant relationship between the two instruments exists ($p < .05$).

Very high reliability coefficients were attained on the semantic differential. On the concrete/symbolic continuum the Child Care Group II had a coefficient of .46 which was the lowest. The remaining groups had coefficients of .77 and higher. The reliability coefficients for the structured/unstructured continuum ranged from the Child Care Group II value of .85 on up.

Table II-3

Correlation Between Likert and
Semantic Differential Scores

Group	N	Concrete/ Symbolic	Structured/ Unstructured
Child Care Group I	21	- .08	- .02
Accounting II	22	.63	.50
Auto Technology	12	.14	.63
Total	55	.18	.33

Final Test Administration

Based on data gathered statistically and in personal conversation with the participants revisions were made on the instrument. Revisions were made to improve reliability of the concrete/symbolic dimension, to improve instrument readability and to make the statements more specific. (See Appendix C.) The instrument was duplicated and assembled and arrangements were made to administer the final form.

The final instrument was enlarged by two statements which necessitated a change in the computer program. One statement was added to each continuum therefore increasing the continuum range to a low of 11 for the symbolic and unstructured dimensions to a high of 55 for the concrete and structured dimensions. No changes in the method of scoring the final instrument were made. The reader is directed to a previous section in this chapter dealing with scoring procedures.

Arrangements were made on the campus of the University of Wisconsin - Stout to administer the instrument to groups of art and psychology majors. It was anticipated that these groups could offer some valuable data in the area of symbolic and unstructured learning styles. This group consisted of a total of 57 individuals who had made definite commitments to the above programs of studies.

The final administration was conducted at Fox Valley Technical Institute with 140 students participating. Arrangements for this administration were made by Dr. Urban Oen on the Fox Valley Campus in cooperation with teachers of the following groups:

1. Machine Tool IV
2. Machine Shop II

3. Mechanical Design IV
4. Mechanical Design II
5. Industrial Drafting II
6. Auto Body Repair IV
7. Electronics Technology IV
8. Conservation IV

These groups were selected on the basis of learning styles assumed to be evident in various vocational programs. Students were engaged in one and two year vocational diploma programs and two year associate of arts degree programs.

Final Instrument Reliability

The basic instrument as designed for the pilot administration was specifically changed to improve reliability, especially in the concrete/symbolic continuum. Table II-4 provides data on the final instrument reliability.

Table II-4

RELIABILITY COEFFICIENTS FOR EACH LEARNING STYLE DIMENSION FOR THE GROUPS TESTED

Group	Concrete/ Symbolic	Structured/ Unstructured
Drawing 500	.35*	.85*
Life Drawing	.00*	.72*
Psychology	.00	.85
Machine Tool IV	.04	.83
Machine Shop II	.00	.60
Mechanical Design IV	.59	.82
Mechanical Design II	.29	.77
Industrial Drafting II	.00	.58
Auto Body IV	.01	.76
Electronics Technology IV	.01	.81
Conservation IV	.27	.82
Total Group	.22**	.81**

* Reliability coefficients calculated separately from remaining groups.
**Total group reliability coefficients do not include art groups.

As indicated in the Table reliability coefficients for the concrete/symbolic continuum declined and those for the structured/unstructured continuum increased slightly. The interpretation of the coefficients based on a comparison between the pilot and final administration indicates the possibility of other variables functioning in the concrete/symbolic dimension. Few changes were made in the instrument on the structured/unstructured items. It can be assumed that this section of the instrument measured the variables as defined in the study with adequate precision.

Further analysis of the data gathered provides interesting insights into the area of vocational-technical students' learning styles. Interpretation of data and findings are presented in Chapter III.

CHAPTER III

SURVEY RESULTS

As noted in the previous chapter, the learning styles survey instrument was developed on the basis of a review of literature and information contained in the Learning Styles Matrix. The first draft of the instrument was piloted and revised before being reproduced in final form. Except for three groups of students on the University of Wisconsin - Stout campus all data collection was conducted at Fox Valley Technical Institute, Appleton, Wisconsin. The surveys were administered to the participants in their respective classrooms, therefore insuring a 100% return.

Pilot Instrument Design

As described in a previous chapter, the instrument was designed to measure concrete, symbolic, structured and unstructured learning styles. It was felt that individuals fell somewhere along a continuum and as they approached the continuum end points their learning would be more influenced by that particular style. Two continuums were established in the study. Concrete to symbolic and structured to unstructured styles formed the two continuums. Based on the matrix, a pilot instrument was developed to identify the point along each of the two continuums where an individual scored.

The twenty items contained in the pilot instrument reflected various points between the end poles. (See Appendix B.) Items one to ten were designed to measure concrete/symbolic learning styles. If students accepted the first five items as being extremely valuable to them in a learning situation they received the maximum (25) amount of points possible for that style. If they rejected items six to ten as being of no value to them in a learning situation they received 25 additional points for a maximum of 50. This score reflects a very concrete learning style. The valence on items six to ten was designated as being negative for ease of scoring the instrument. Therefore responses of "No Value" actually were scored as being worth 5 points for items 6-10.

The high scores were designated to reflect the concrete and structured learning styles. The low values which are generated by responding "strongly disagree" to "concrete" and "structured" items and "strongly agree" to "symbolic" and "unstructured" would indicate the symbolic and unstructured learning styles.

By administering the instrument to groups of students in a variety of vocational and technical programs of studies, learning style data were gathered on each group and used in determining if the learning style(s) in each program match the teaching style or the characteristic style reflected in each program. Data were also accumulated to provide information on individual student styles which will aid the teacher in offering alternative methods of instruction to individuals with styles vastly divergent from the group style.

Mean scores were used to identify the typical learning style in each group. A comparison of individual scores within the group with the group mean provided information related to the need for a variety of teaching styles for each program. Information accumulated on the pilot administration was used for two purposes: (1) determining revisions on the final instrument both in directions and in the statements and (2) provide data on the participating groups to determine if the dimensions measured actually reflected the learning styles characteristic of the group measured.

Pilot Groups

Six groups at Fox Valley Technical Institute participated in the pilot instrument administrations. The groups were chosen on the basis of the learning styles assumed to be characteristic of the students in each of the vocational programs. Programs were selected to provide divergent learning styles. An example of this assumption can be made with the Automobile Technology group. It was assumed Automobile Technology would attract students with concrete and structured learning styles. Therefore the results of the data on this group should reflect these assumptions if the instrument measures what it is designed to measure. Besides the Automobile Technology program, the other five groups were: (1) Child Care Groups I, II and III; (2) Audio-Visual Tutorial Typing and; (3) Accounting II.

Ninety-eight individuals participated in the pilot administration. The administration was conducted by entering the participating classes, issuing the instrument and IBM answer sheets, briefly explaining the nature of the instrument, reading the directions and providing information on answer sheet marking, and at the completion of the responding time asking the group if they had any questions on anything that was not clear and understandable. This final question provided valuable information on items that were poorly constructed, and the students' general reactions to the instrument.

Results

Concrete/Symbolic Instrument Analysis

Table II-2 provides information on the reliability coefficients attained by the concrete/symbolic continuum. The overall reliability of .29 indicates the instrument had a low level of precision in measuring the concrete/symbolic continuum. Four groups provided very low correlations and two of the four had zero reliability coefficients. The total group item analysis for the concrete/symbolic continuum is found in Table III-1.

Table III-1 indicates that items 1, 2, 3, 5, 6, 8 and 9 provided reliability coefficients less than the + .40 level. Revisions in these

Table III-1

PILOT ADMINISTRATION ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.040	0.163	0.316	0.479	4.234	0.866	0.320	3.645	4.435	4.978	1.333
2	0.000	0.061	0.112	0.234	0.408	0.183	3.540	1.098	0.319	2.826	3.725	4.337	1.511
3	0.000	0.020	0.091	0.326	0.295	0.265	3.693	1.024	0.350	2.921	3.706	4.557	1.635
4	0.000	0.010	0.010	0.142	0.285	0.551	4.357	0.836	0.421	3.803	4.592	5.046	1.242
5	0.000	0.030	0.132	0.346	0.275	0.214	3.510	1.061	0.176	2.750	3.470	4.370	1.620
6	0.000	0.244	0.387	0.234	0.112	0.020	2.275	1.018	0.089	1.513	2.157	3.000	1.486
7	0.010	0.091	0.265	0.224	0.316	0.091	3.051	1.152	0.630	2.096	3.136	4.032	1.936
8	0.000	0.030	0.112	0.275	0.336	0.244	3.653	1.060	0.365	2.888	3.742	4.484	1.595
9	0.000	0.061	0.112	0.183	0.408	0.234	3.642	1.136	0.623	2.916	3.850	4.462	1.545
10	0.000	0.010	0.030	0.275	0.448	0.234	3.867	0.840	0.367	3.259	3.909	4.465	1.206

N=98

Note: Items 1-5 are positive valence items and are scored 1-5.
Items 5-1 are negative valence items and are scored 5-1.

items were considered in order to improve reliability in the final instrument administration.

Referring to Appendix E will provide the reader with an item analysis of each individual group participating in the pilot administration. Looking at the item analysis for the groups which had low reliability coefficients also indicated that these items needed restructuring for the final instrument.

Recalling that items 1 to 5 measure the concrete learning dimension, Table III-1 also provides information on the overall pilot sample response to these items. Items 6 to 10 measured the symbolic dimension and it can easily be seen that the mean scores for these items is less than the concrete (items 1-5) items. The interpretation made at this point is that the total group of 98 individuals tended toward the concrete end of the continuum. Further interpretation of data will clarify this judgment.

The upper limits or concrete end of the concrete/symbolic continuum has been determined to be 50 and the low or symbolic end has been determined to be 10. Table III-2 provides the reader with the frequency distribution for the concrete/symbolic continuum. The midpoint is determined to be 30 and is designated as the value an individual received if they responded to all items at the 3 level or at the "Of Average Value" level on the instrument or if their responses averaged to three. The frequency distribution indicates that the entire group scored significantly above the midpoint with a mean score of 35.79 for the distribution. The midpoint is designated as the center point along the continuum and is that point determined to reflect a mix between learning styles. The conclusion is that the entire group as a whole tended to view themselves as learning in situations that provided them with "hands on" active involvement with an object, materials or tools. In view of the fact that vocational-technical students responded to the instrument it is not surprising that their responses should tend toward the concrete end of the learning style continuum. It was felt by the researcher and advisor that the analysis indicated the instrument was measuring the concrete/symbolic continuum.

The frequency distribution also indicates there was a considerable amount of variability in the scores. Those individuals located near the midpoint may employ a mix of concrete/symbolic learning styles. Students scoring at either end of the continuum would prefer concrete or symbolic learning experiences. One could question the success an individual was having if he/she were enrolled in a program opposite from the tested learning style. Also one could provide alternative learning strategies to individuals scoring at the high or low ends of the continuum especially if enrolled in a program with an opposite mode of instruction.

The graph in Figure III-1 offers the reader a comparison of the mean scores of individual groups that participated in the pilot administration. Located on the vertical axis is the concrete/symbolic continuum and the height of each bar indicates whether the group's mean response tended toward either the concrete or symbolic end. All groups tended to score towards the concrete end of the continuum. The four groups that scored higher than the total group mean contained a larger number of concrete

Table III-2

PILOT ADMINISTRATION TOTAL GROUP FREQUENCY DISTRIBUTION
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

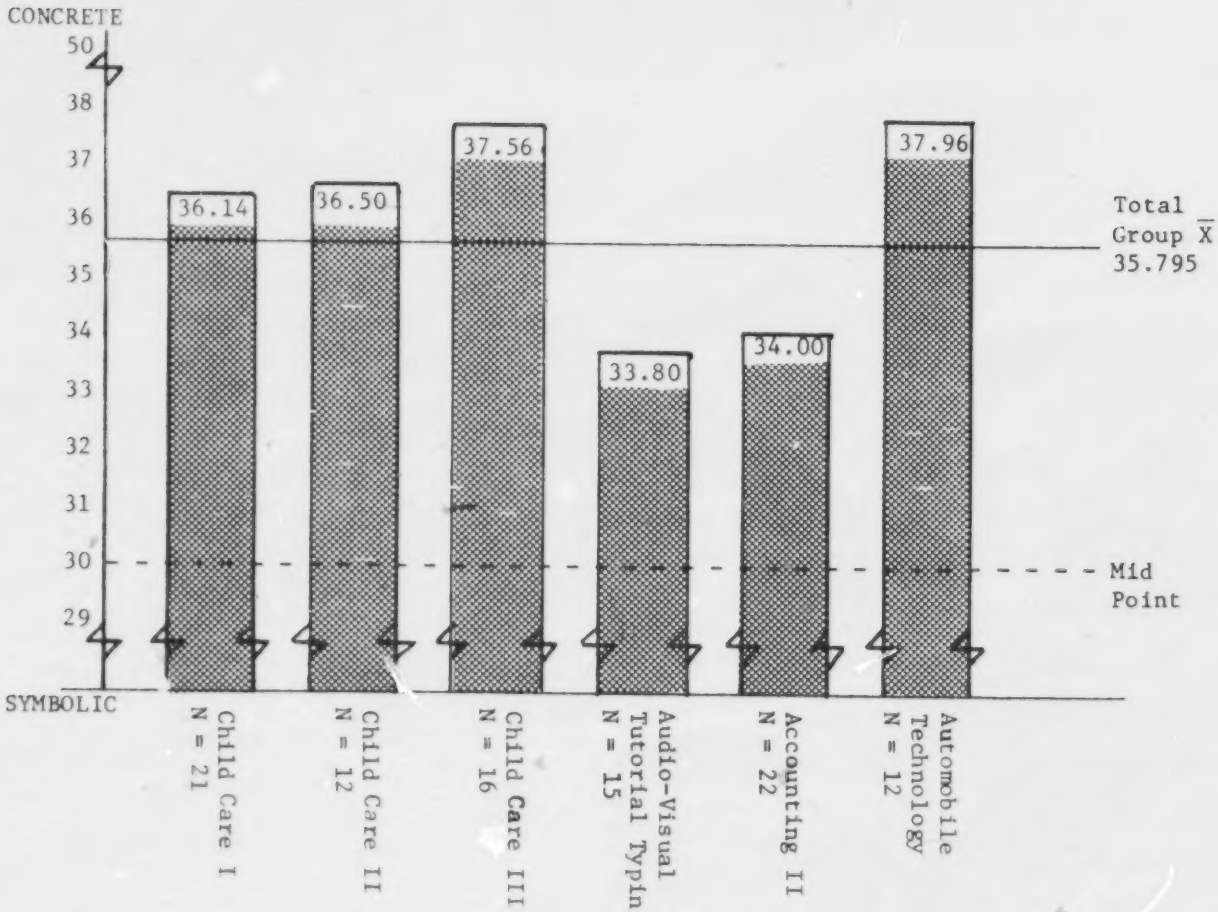
	Frequency Distribution
44	* *
43	*
42	* * * * *
41	* * * * *
40	* * * *
39	* * * * * * *
38	* * * * * * * *
37	* * * * * * * * *
36	* * * * * * * * * *
35	* * * * * * *
34	* * * * * * * * * * * * * * *
33	* * * * * *
32	* * * * * * * * * * * *
31	* * *
30	* -------Concrete/Symbolic Continuum Midpoint
29	* * *
28	*
27	
26	
25	*

N = 98 $\bar{X}$ = 35.79

sd.= 3.33

Figure III-1

PILOT ADMINISTRATION COMPARISON OF INDIVIDUAL GROUPS
ON THE CONCRETE/SYMBOLIC
LEARNING STYLE DIMENSION



learners than the two groups scoring below the mean. The implication made here is that more symbolic learning styles were evident in the Audio-Visual Tutorial Typing and Accounting II groups than in any of the other four groups. These two groups account for 37% of the individuals in the pilot sample. Emphasis is made of the fact that the means reflect typical group scores on the instrument. If individualization of instruction is to occur, one must evaluate individual scores to determine if some of the assumptions stated up to this point are evident. Each teacher using learning styles as a means of individualization of instruction needs to be cognizant of the fact that within one class or one program of studies, during any one particular period of time, any number of learning styles may be evident. If a teacher is aware that certain individuals have difficulty learning in a specific instructional environment he can identify alternate instructional modes for their use.

It was not anticipated that the Child Care Groups would score so highly concrete. In reviewing the objectives of the program one realizes it does involve the individual student in some form of individual or group activity either with a child or in preparing learning activities for the child. The Automobile Technology groups attained the highest or most concrete scores. This appears to be a logical result. Automobile Technology is highly concrete and the total group should score toward that end of the continuum.

The remaining two groups, Typing and Accounting, tended to have scores near the midpoint of the concrete/symbolic continuum. One cannot interpret these groups as being either concrete or symbolic. They view themselves as functioning effectively and efficiently in either dimension but not to any large extreme either way. It may be that these students prefer a mix of both styles.

Even with the low (+ .29) reliability attained on the concrete/symbolic learning style instrument, valuable information can be obtained from the data. An attempt has been made to clarify this to the reader and further analysis of the data will be conducted at the completion of the structured/unstructured dimension. The pilot administration provided the researcher with an idea of the instrument value and based on the differences between groups a construct of learning styles has been verified.

Structured/Unstructured Instrument Analysis

Table II-2 indicates that a reliability coefficient of .80 was attained on the structured/unstructured learning style continuum. The pilot instrument provided a precise measure of this dimension. Five of the groups participating in the pilot instrumentation provided reliability values of .75 and larger. One group of Child Care students had a coefficient of .64 which is determined to be acceptable.

Analysis of the structured/unstructured items is provided in Table III-3. Responses on statements 11 and 13 had the lowest correlations with total scores and revisions in these items were undertaken in an attempt to improve their reliability within the continuum. All other items appeared to be functioning in an acceptable manner.

Table III-3

PILOT ADMINISTRATION ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.204	0.234	0.377	0.132	0.051	2.591	1.105	0.251	1.695	2.662	3.324	1.628
12	0.000	0.020	0.214	0.438	0.193	0.132	3.204	0.989	0.593	2.534	3.104	3.894	1.359
13	0.000	0.122	0.285	0.326	0.163	0.102	2.836	1.149	0.370	1.946	2.781	3.593	1.647
14	0.000	0.040	0.132	0.275	0.306	0.244	3.581	1.115	0.449	2.777	3.666	4.483	1.705
15	0.000	0.193	0.265	0.295	0.204	0.040	2.632	1.128	0.468	1.711	2.637	3.482	1.771
16	0.000	0.224	0.367	0.244	0.163	0.000	2.346	1.001	0.576	1.569	2.250	3.145	1.576
17	0.000	0.142	0.408	0.275	0.142	0.030	2.510	1.002	0.551	1.762	2.375	3.222	1.459
18	0.000	0.061	0.193	0.418	0.244	0.081	3.091	1.000	0.547	2.473	3.085	3.812	1.338
19	0.000	0.010	0.120	0.081	0.183	0.704	4.551	0.809	0.454	4.250	4.789	5.144	0.894
20	0.010	0.040	0.081	0.357	0.397	0.112	3.463	0.942	0.432	2.857	3.551	4.179	1.322

N=98

Note: Items 11-15 are positive valence items and are scored 1-5.
Items 16-20 are negative valence items and are scored 5-1.

Appendix F will provide the reader with an item analysis on each item based on data obtained from each separate pilot group. Statement 11 provided the only negative correlation of the entire pilot group and this occured only in the Automobile Technology group. All other items had a positive relationship with total test scores. Based on the high reliability for the total group this should be expected. Naturally some items do not function at a high level in some groups, but overall it appeared that the structured/unstructured items functioned effectively and formed a precise measuring device.

The minimum and maximum scores for this instrument were the same for the structured/unstructured continuum as for the concrete/symbolic dimension. The frequency distribution shown in Table III-4 provides the reader with a graphic description of the distribution scores of all of the students in the pilot administration. The range of scores is considerably larger for this continuum than on the concrete/symbolic continuum.

The continuum midpoint is determined to be 30 and is designated as the value an individual received if his response to all items averaged to three. The frequency distribution, indicates that the entire pilot group's mean located near the continuum midpoint. The conclusion is that the entire group as a whole tended to view themselves as learning in situations employing a mix of structured/unstructured learning activities.

Individuals tended to locate along a wide spread of the continuum. The use of one style would not appear appropriate except for those individuals locating at the extreme continuum end points. Individual placement along the continuum can provide data to a teacher when determining the various mix of learning styles to select for his classroom.

Figure III-2 provides the reader with a visual comparison of the mean scores of the groups participating in the pilot administration. Comparing the mean scores one can easily compare separate groups. It is obvious that all groups, except Child Care II, tended towards the instrument midpoint of 30. The Accounting II group provided a score slightly below the midpoint. The implication is that individuals within each group tended to score at or very near the midpoint. Each group, not including Child Care II, could function within a classroom employing a mix of structured/unstructured learning activities. The Child Care II group tended towards the structured end of the continuum suggesting a desire for more structured learning activities.

Within each group considerable variability will exist. The distribution of scores reproduced in Table III-4 indicates a wide distribution along the continuum for the pilot group. Due to the fact that each individual group tends to locate near the midpoint indicates that within each separate group a wide range of scores exist along the continuum.

Table III-5 reports the means and standard deviations for both continuums. The data in the Table indicate that the members of the groups tended to view themselves as employing a concrete style and a mix of structured/unstructured learning styles to effectively and efficiently

Table III-4

PILOT ADMINISTRATION FREQUENCY DISTRIBUTION STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

	Frequency Distribution
42	* *
41	* *
40	*
39	* *
38	* * *
37	* * * * *
36	* * *
35	* * *
34	* * * * *
33	* * * * * *
32	* * * * * * * *
31	* * * * * * * * *
30	* * * -------Structured/Unstructured Continuum Midpoint
29	* * * * * *
28	* * * * * * * * * * * * * *
27	* * * * * * * * * * * *
26	* * * * * * *
25	* * *
24	*
23	* *
22	
21	
20	*
19	
18	*

N = 98 $\overline{X}$ = 30.77

sd.= 3.58

Figure III-2

PILOT ADMINISTRATION COMPARISON OF INDIVIDUAL GROUPS
ON THE STRUCTURED/UNSTRUCTURED
LEARNING STYLE DIMENSION

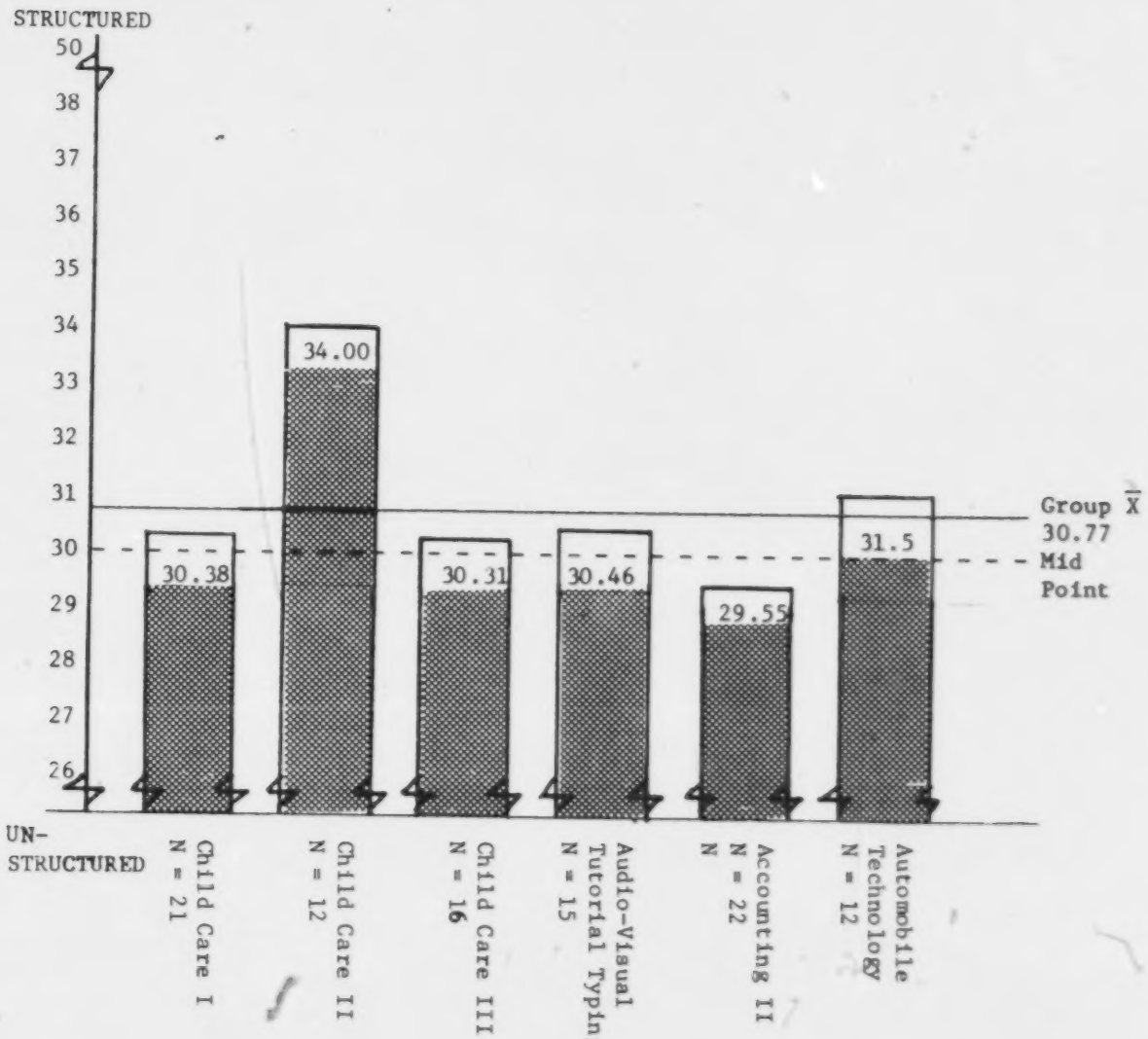


Table III-5

PILOT ADMINISTRATION GROUP MEAN AND
STANDARD DEVIATION COMPARISON
FOR EACH LEARNING STYLE
DIMENSION FOR THE
GROUPS TESTED

Group	Concrete/ Symbolic	Structured/ Un-Structured
Child Care I		
$\bar{X}$	36.14	30.38
Sd	4.60	3.82
Child Care II		
$\bar{X}$	36.50	34.00
Sd	2.90	4.76
Child Care III		
$\bar{X}$	37.56	30.31
Sd	3.35	5.57
Audio-Visual Tutorial Typing		
$\bar{X}$	33.80	30.46
Sd	3.12	5.36
Accounting II		
$\bar{X}$	34.00	29.54
Sd	2.57	3.93
Automobile Technology		
$\bar{X}$	37.91	31.50
Sd	3.32	4.44
Total Group		
$\bar{X}$	35.79	30.77

learn knowledges, skills and attitudes. However, considerable variability in styles was noted within groups (denoted by the standard deviations).

The researcher was also concerned about the degree of independence between the two sets of scores. Figures III-3 to III-8 graphically show the relationship between individuals' scores on the concrete/symbolic and structured/unstructured continuums. The location of an individual's plot is made by locating his concrete/symbolic raw score on the "X" axis and his structured/unstructured score on the "Y" axis. The intersect of lines drawn through these points and parallel to the other axis locates the plot.

The plots indicate that individuals within groups locate over a vastly wide area of the diagram and the shape of the scatter diagram gives an estimate of the correlation between the two measures. Plots offer an individual teacher an analysis of the group he/she is presently teaching. If the class were known to present a highly concrete/structured learning environment and the group's plot indicated that their preferred learning style was considerable different, alternative learning experiences should be made available. Interesting hypotheses can be made when viewing the plottings.

Figure III-3 shows the plottings for the Child Care Group I. Within the group most of the individuals locate toward the concrete end of the continuum and near the midpoint of the structured/unstructured continuum. It is noted that one individual has located outside of the total group plottings. This individual has scored below the concrete midpoint and towards the highly structured end of the continuum. Some individuals within the other groups tend to locate outside the total group placement.

The plots indicate very little correlation exists between the two continuum variables. The continuums are separate and independent variables that exist within the learner and have influence on his/her learning.

Based on the interpretation of the pilot instrumentation data some changes were made on the instrument in preparation for the final administration. This will be discussed in the next section.

Final Instrument Design

The final design of the Learning Styles Instrument contained some changes in the wording of several of the statements, especially items designed to measure the concrete/symbolic continuum. One additional item was constructed and added to both continuums increasing each continuum to 11 statements and the entire instrument to 22 statements.

The additional item appears as number 6 in the final instrument. Therefore statements 1, 2, 3 and 5 were revised. Statement 6 was an additional item and statements 6, 8 and 9 appear as items 7, 9 and 10 respectively in the final instrument. Revisions were made in an attempt to improve item reliability. Based on comparisons between Table III-1

Figure III-3

PILOT ADMINISTRATION
CHILD CARE GROUP 1

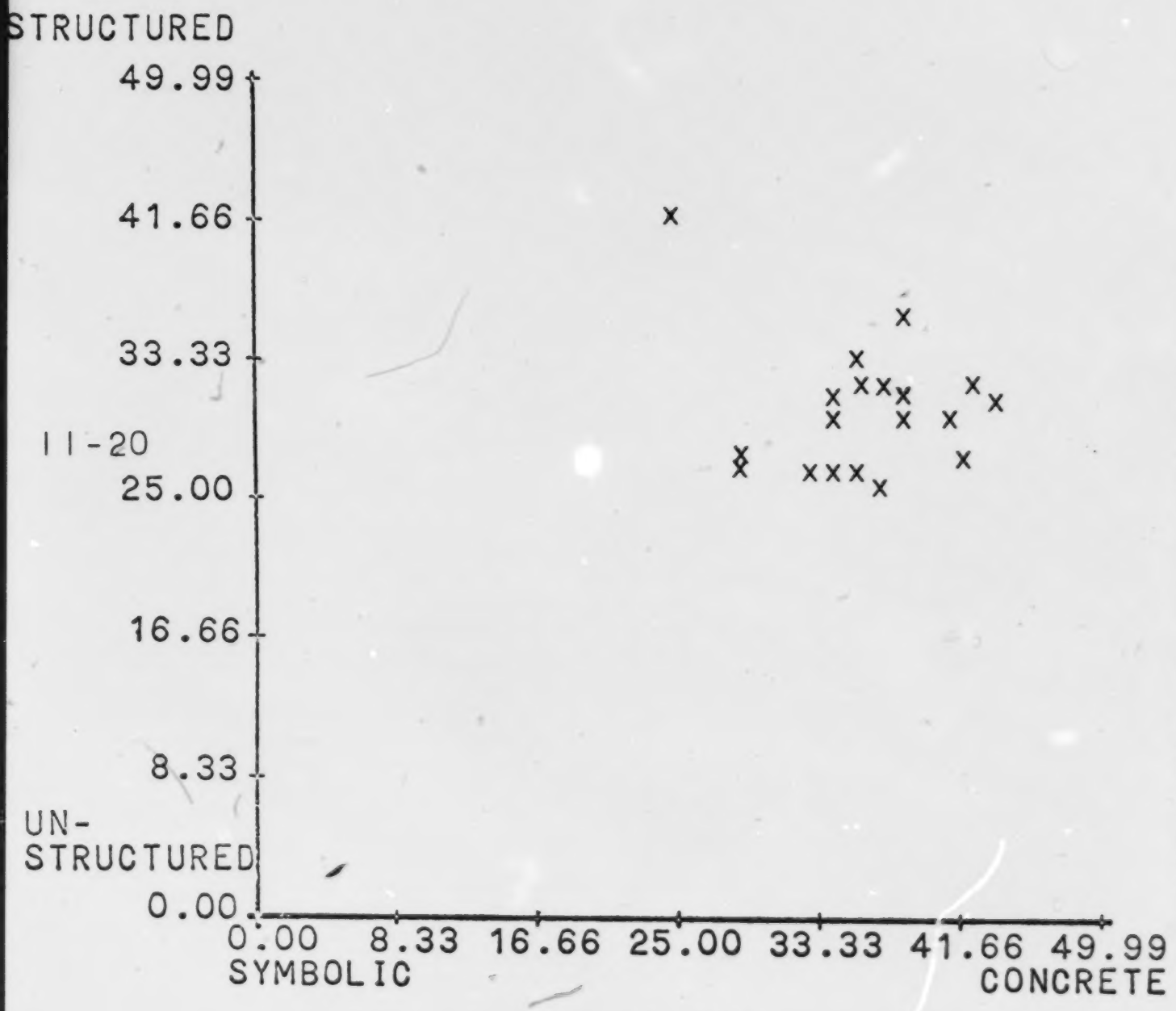


Figure III-4

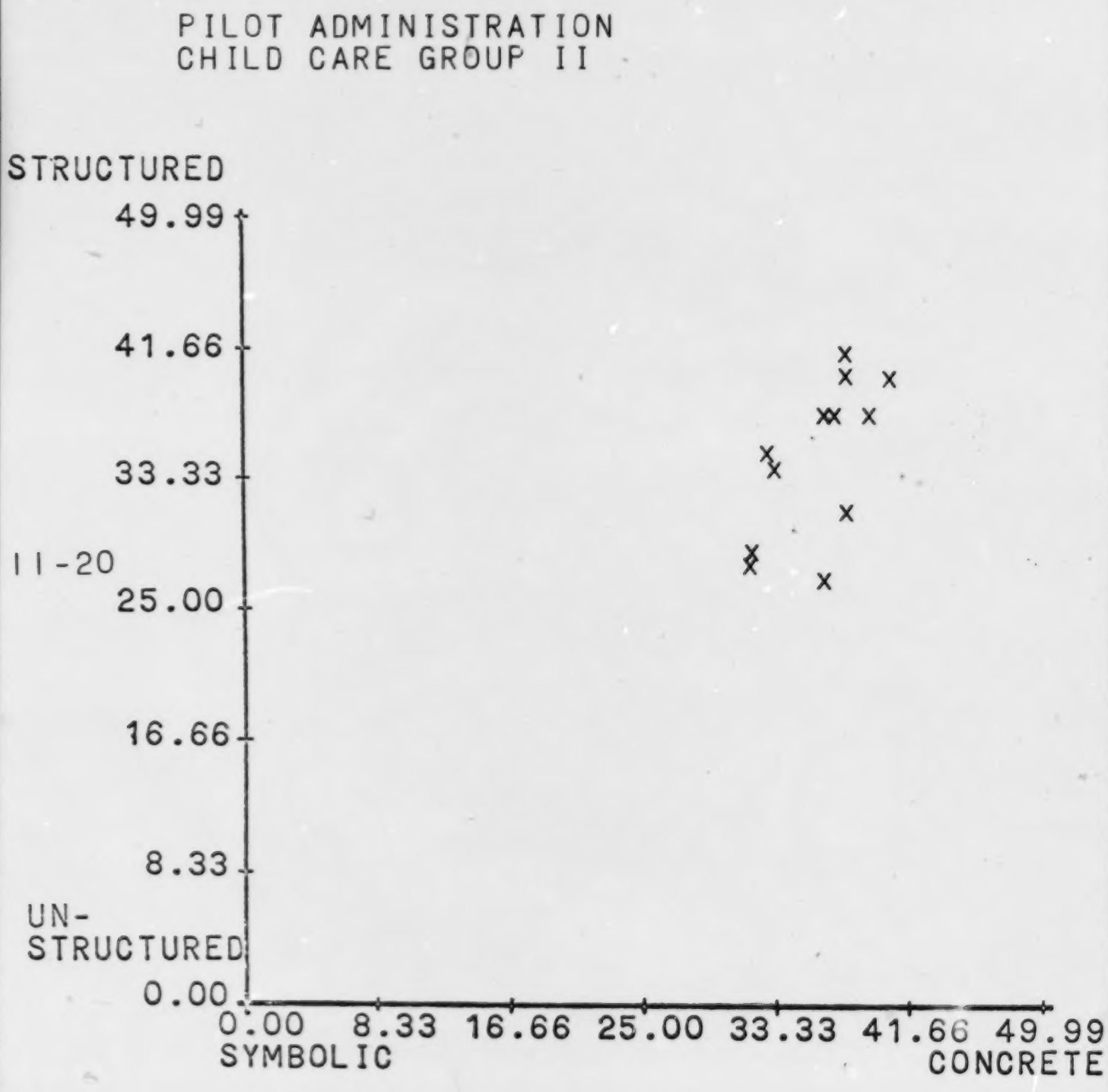

PILOT ADMINISTRATION
CHILD CARE GROUP II
STRUCTURED
49.99
41.66
33.33
II-20
25.00
16.66
8.33
UN-
STRUCTURED
0.00
0.00 8.33 16.66 25.00 33.33 41.66 49.99
SYMBOLIC
CONCRETE
1-10

Figure III-5

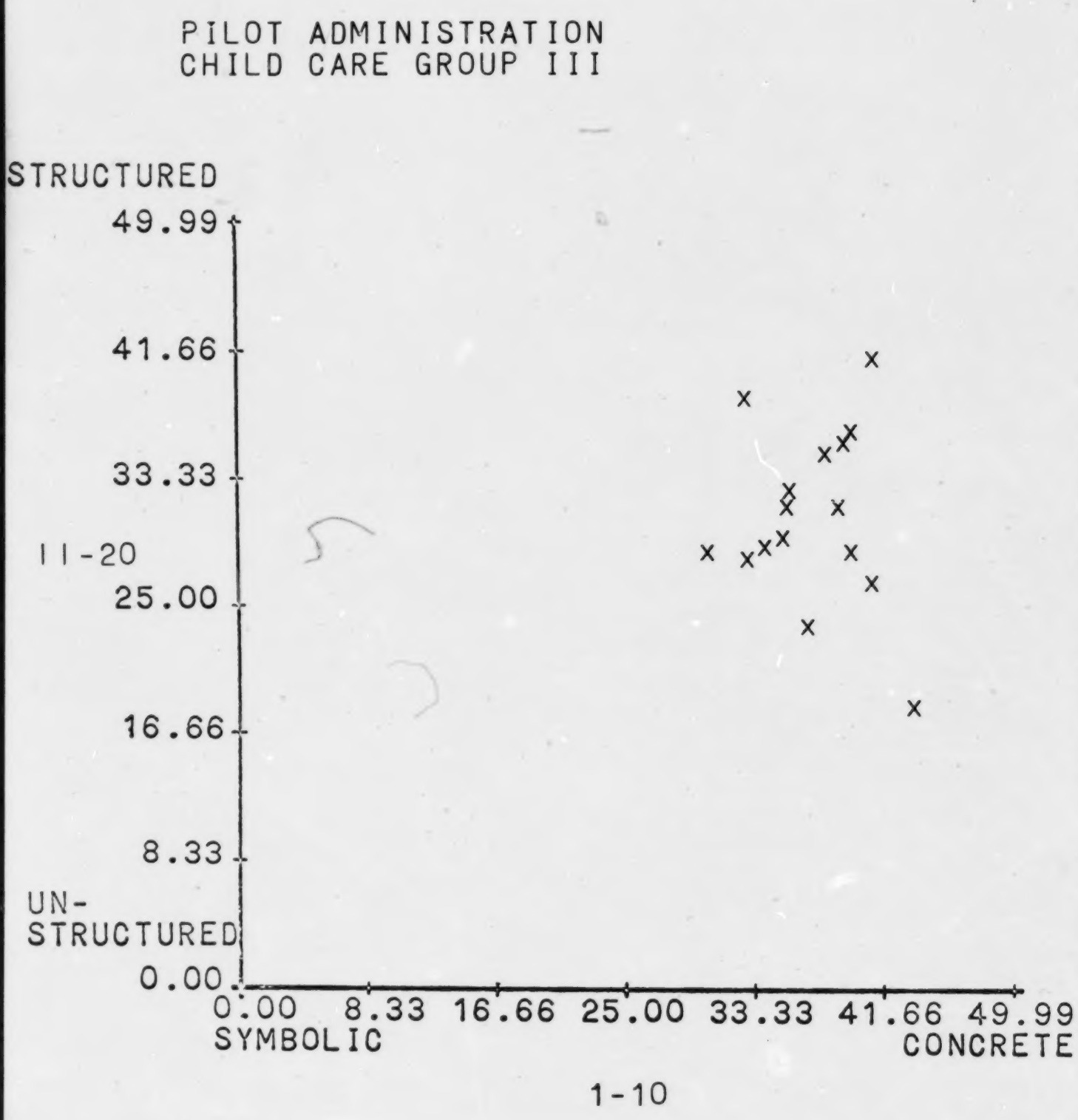
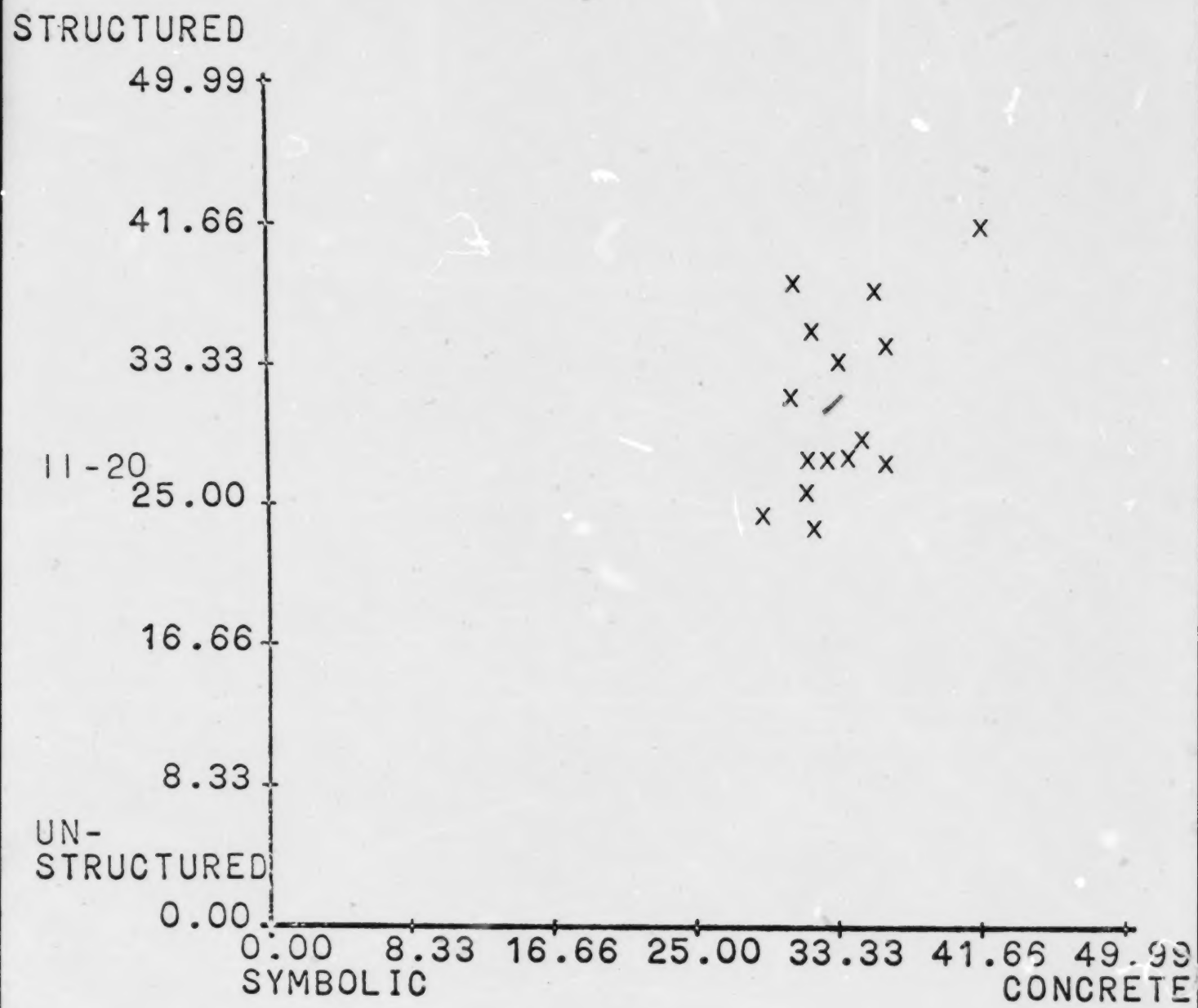

PILOT ADMINISTRATION
CHILD CARE GROUP III
STRUCTURED
49.99
41.66
33.33
11-20
25.00
16.66
8.33
UN-
STRUCTURED
0.00
0.00 8.33 16.66 25.00 33.33 41.66 49.99
SYMBOLIC
CONCRETE
1-10

Figure III-6

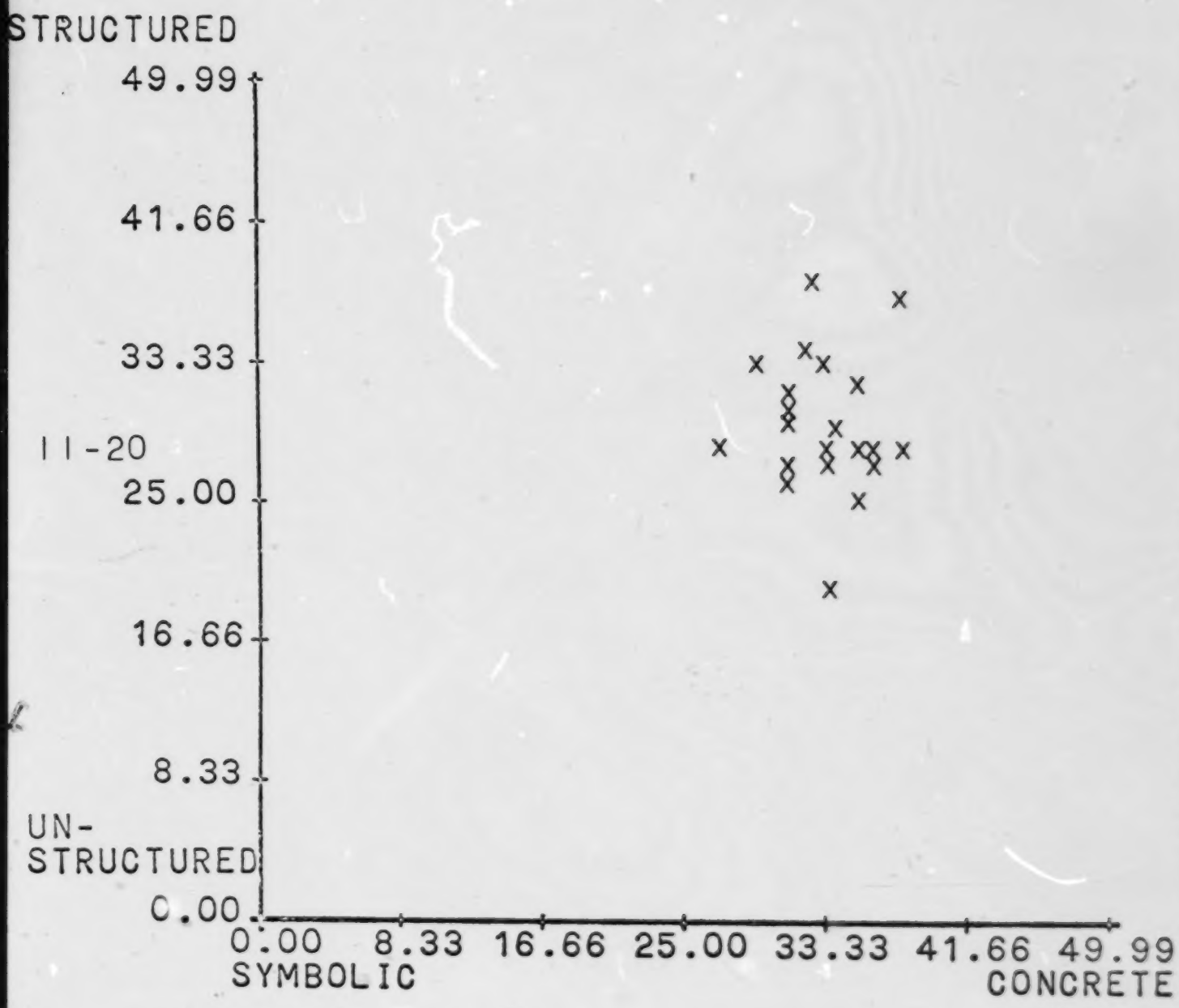
PILOT ADMINISTRATION
AUDIO-VISUAL TUTORIAL TYPING



1-10

Figure III-7

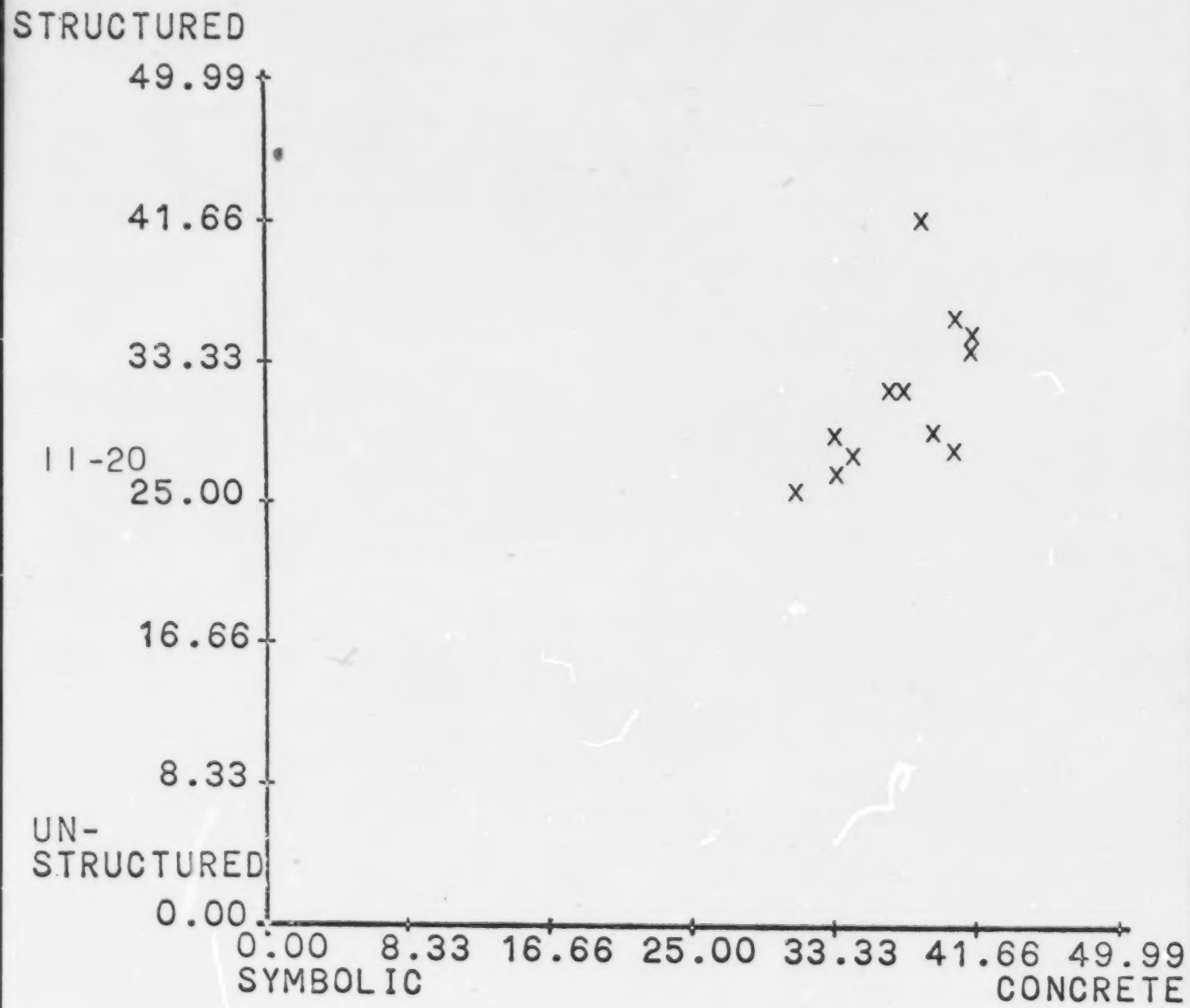
PILOT ADMINISTRATION
ACCOUNTING II



1-10

Figure III-8

PILOT ADMINISTRATION
AUTOMOBILE TECHNOLOGY



1-10

and Table III-6 concrete/symbolic item reliability for pilot statements 1 and 6 were improved. Reliability for all other items decreased slightly between pilot and final administrations.

Statements on the structured/unstructured section of the instrument were reworded to make them more specific. Reliability for the structured/unstructured section remained unchanged between pilot and final administrations.

Arrangements were made on the University of Wisconsin - Stout campus to administer the instrument to students majoring in art and psychology. Fifty-seven individuals participated in the final administration on the Stout campus. Dr. Urban Oen was contacted to arrange for students from a variety of programs at Fox Valley Technical Institute to participate in the final administration. Eight Fox Valley groups participated with a combined total of 140 participating individuals.

The basic format as previously discussed in the pilot administration was adhered to during final instrument development. All participating groups were chosen under the assumption that the group exhibited certain learning styles based on the characteristics of the program of studies. Participants were provided an instrument booklet, pencil and IBM 1230 Document No. 506 for recording their reactions. Each individual was assigned an identification number before the response sheets were supplied to the computer. A weighted scores analysis program was applied to summarize the data from the various groups. (See Appendix D.)

Results

Concrete/Symbolic Instrument Analysis

Table II-4 presents the reliability coefficients attained for the two continuums included in the final instrument. The reliability coefficient for the total groups on the concrete/symbolic dimension decreased slightly from the coefficients attained in the pilot administration. Final reliability was determined to be + .22 seven hundreths of a point less than the pilot instrument reliability. Two possible explanations exist for the low coefficient: (1) a symbolic instrument was designed to measure the concrete/symbolic continuum; thus, a negative attitude may exist from an individual possessing a concrete style and; (2) some other variables may exist in the statements used to measure the continuum, such as attitude toward the teacher and teaching style, which affect instrument reliability.

No significant improvement in the item correlations was attained between the pilot and final administrations of the instruments. Table III-6 provides information on the item analysis for the total group participating in the final administration. This Table includes data from all groups except the two art groups from the University of Wisconsin - Stout campus. The art and psychology groups were selected on the basis of assumed learning styles characteristic for their particular program

of studies. It was felt that by evaluating their learning styles, comparison with other groups could be conducted. Also if the instrument tended to substantiate the previous assumptions, instrument validity could be determined. Data on the art groups item analysis can be found in Appendix G.

Items 1-6 were developed to measure the concrete dimension and items 7-11 were developed to measure the symbolic dimension. Once again it is emphasized that a continuum was formed with the highly concrete end designated as having a value of 55 and the symbolic or low end of the continuum having a value of 11. These values are determined by an individual's response to the various statements and compilation of data based on the valence. The concrete items held a positive valence and the symbolic items held a negative valence.

A highly concrete individual attaining a maximum score of 55 would have accepted items 1-6 at the "Extremely Valuable" end and would have rejected symbolic items 7-11. Negative valence items 7-11 were scored using reverse values of 5-4-3-2-1. Likewise an individual possessing a highly symbolic style would have replied to the previous items in an opposite manner. The eleven items were designed to measure the continuum defined by concrete at one pole and symbolic at the other pole. An individual's position on the continuum depends on his acceptance or rejection of the value of the learning experience defined in each statement to the responder. Individuals locate along the continuum. Location towards the end indicates a high influence by that style. Locating towards the midpoint indicates a desire for a mix of learning styles.

The data contained in Table III-6 provide the reader with the total group response pattern for the concrete/symbolic continuum. A comparison between Table III-1 and Table III-6 will indicate the change in correlation attained in the pilot and final instrument administration. The reader is directed to the section entitled Final Instrument Design to determine which items were revised. It must be recalled, when viewing the Table, that items 7-11 have a negative valence. Disagreement with these items results in higher concrete scores. A mean of 2 indicates that the average response for that item is two. But calculating the individual's total score, this response would receive 4 points. A mean value of 2 on items 7-11 would score as a value of 4 which would be interpreted as a rejection of the symbolic items and an acceptance of the concrete items.

Frequency Distribution

Tables III-7 and III-8 provide the reader with graphic description of the range established on the concrete/symbolic continuum. The potential range of scores varies from highly concrete designated at a value of 55 and highly symbolic designated at a value of 11. Table III-7 is a frequency distribution for the art groups that participated in the instrumentation on the University of Wisconsin - Stout campus. Table III-8 provides similar information on the remaining groups.

Table III-6

FINAL INSTRUMENT ADMINISTRATION TOTAL GROUP ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.011	0.040	0.064	0.350	0.532	4.350	0.861	0.480	3.879	4.560	5.030	1.151
2	0.000	0.000	0.076	0.309	0.409	0.204	3.742	0.867	0.168	3.061	3.778	4.389	1.327
3	0.000	0.029	0.146	0.368	0.327	0.128	3.380	0.980	0.309	2.702	3.380	4.129	1.427
4	0.000	0.011	0.064	0.233	0.397	0.292	3.894	0.936	0.436	3.243	3.977	4.645	1.401
5	0.000	0.017	0.140	0.502	0.239	0.099	3.263	0.882	0.085	2.683	3.180	3.871	1.188
6	0.000	0.000	0.040	0.169	0.391	0.397	4.146	0.842	0.277	3.600	4.238	4.871	1.270
7	0.005	0.140	0.426	0.304	0.087	0.035	2.447	0.958	0.426	1.753	2.335	3.086	1.333
8	0.000	0.052	0.099	0.374	0.321	0.152	3.421	1.030	0.344	2.761	3.429	4.195	1.433
9	0.000	0.076	0.274	0.345	0.245	0.058	2.935	1.026	0.210	2.132	2.932	3.720	1.587
10	0.000	0 274	0.368	0.274	0.064	0.017	2.181	0.965	0.458	1.409	2.111	2.888	1.478
11	0.005	0.011	0.169	0.292	0.403	0.116	3.447	0.945	0.508	2.730	3.557	4.173	1.443

Note: Does not include items analysis data from Life Drawing and Drawing 500 groups. This data is available in Appendix G, Tables G-1 and G-2.

Table III-7

FINAL INSTRUMENT ADMINISTRATION ART GROUP
FREQUENCY DISTRIBUTION CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

45	*
44	*
43	* * *
42	*
41	*
40	* * * *
39	* *
38	* * * * * *
37	
36	
35	* * *
34	*
33	* * -------Concrete/Symbolic Continuum Midpoint
32	*
31	
30	

N = 36 $\quad \bar{X} = 38.61$

Table III-8

FINAL INSTRUMENT ADMINISTRATION TOTAL GROUP FREQUENCY DISTRIBUTION
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

	Frequency Distribution
48	*
47	*
46	* * *
45	* * * *
44	* * *
43	* * * * * * * * * *
42	* * * * * * * * * *
41	* * * * * * * * * * * * *
40	* * * * * * * * * * * * * * * * * * *
39	* * * * * * * * * * * * * *
38	* *
37	* * * * * * * * * * * * * * * * * * * *
36	* *
35	* * * * * * * * * * * * * * *
34	* * * * *
33	* * * * * * * * * * * * * * * * * * *

The midpoint on the scale, determined by a response average of 3, is 33. Therefore, the art groups tended toward the concrete end of the continuum. This is statistically determined by a mean score of 38.61 and by visual analysis of the frequency distribution. One individual attained a value below the midpoint, the thirty-five remaining individuals' scores ranged from the midpoint up to the high of 45. The researcher's original assumption was that a group of art majors would tend to be highly symbolic. Based on the fact that they are actively and personally involved in phenomena especially in the use of tools, materials and products the contrary would apply. Those individuals who locate near the midpoint may employ a mix of learning styles. Those located near the upper ends of the continuum may be highly influenced by that style. No individual in either of the art groups tended toward the highly symbolic end of the continuum.

Due to the fact that calculations for the art groups were conducted separately, the remaining groups in the final administration are depicted in Table III-8. This distribution reflects the scores of all of the individuals in the psychology groups on the Stout campus and the participants at the Fox Valley Campus. A mean of 38.30 was attained for this group indicating a tendency toward the concrete end of the continuum. The standard deviation and range of scores suggest a variety of concrete/symbolic learning styles were present in the groups tested. Few individuals attained a value below the midpoint of 33.

Looking at the total group mean can determine the typical style evident within the total group. A mean above or below the midpoint indicates a tendency toward one style located at the end pole. A mean near the midpoint suggests a mix of learning styles being favored. Standard deviations can be used to decide if a range of learning styles exists in a sufficient degree to demand a variety of learning environments or alternative forms of instruction.

A visual analysis of Table III-8, the group mean, and the standard deviation indicate that the entire group tended to be located at the concrete end of the continuum. A large number of individuals scored above 43 on the continuum which indicates that the concrete style was effective. These individuals tended to exhibit a highly concrete learning style.

Group Comparisons

Figures III-9 and III-10 offer the reader a visual comparison of the mean scores achieved by each group on the final administration of the concrete/symbolic scale. The two art groups are handled separately as data were computed before the instrument was administered to the remaining nine groups of participants. All groups measured tended to view themselves as emphasizing a concrete strategy that allows the learner to become personally and actively involved with an object or in direct contact with phenomena.

Figure III-9

Comparison of Art Groups on the
Concrete/Symbolic Learning Style Dimension

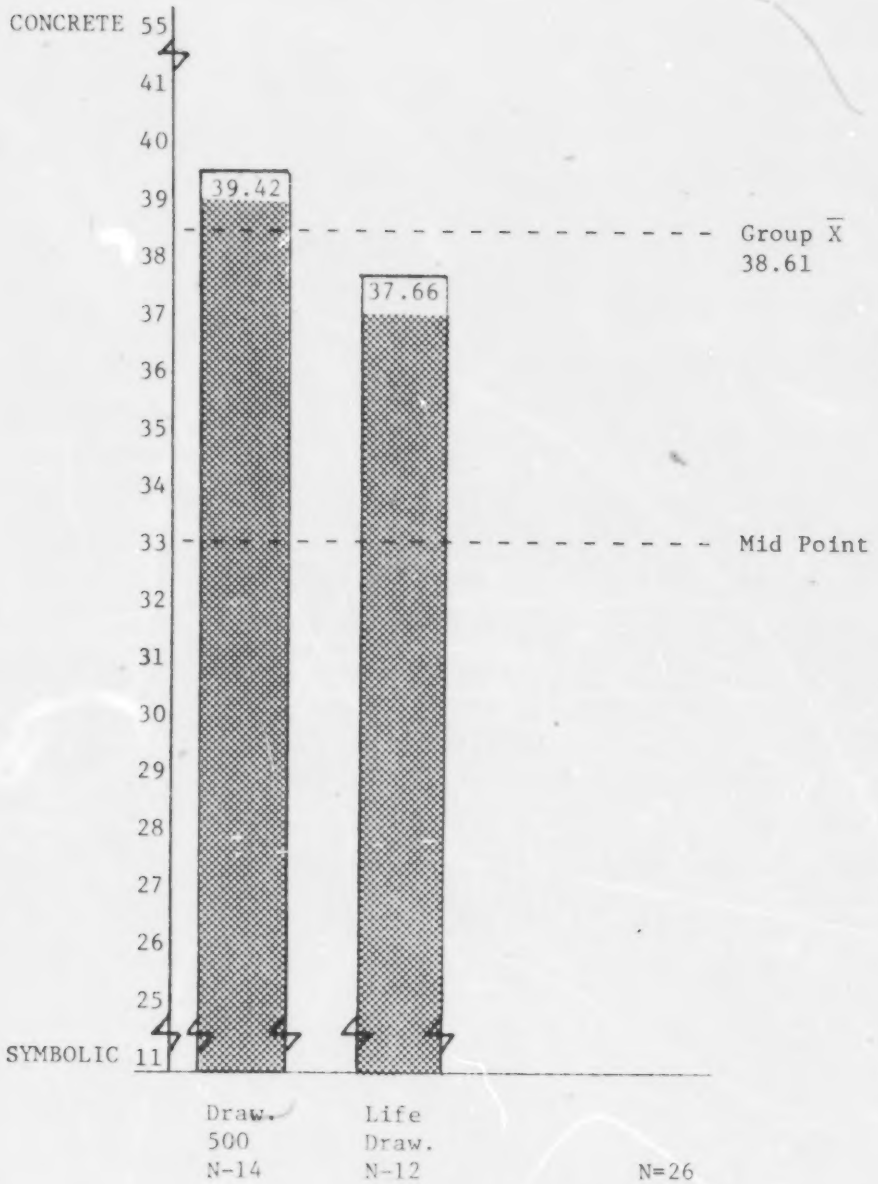
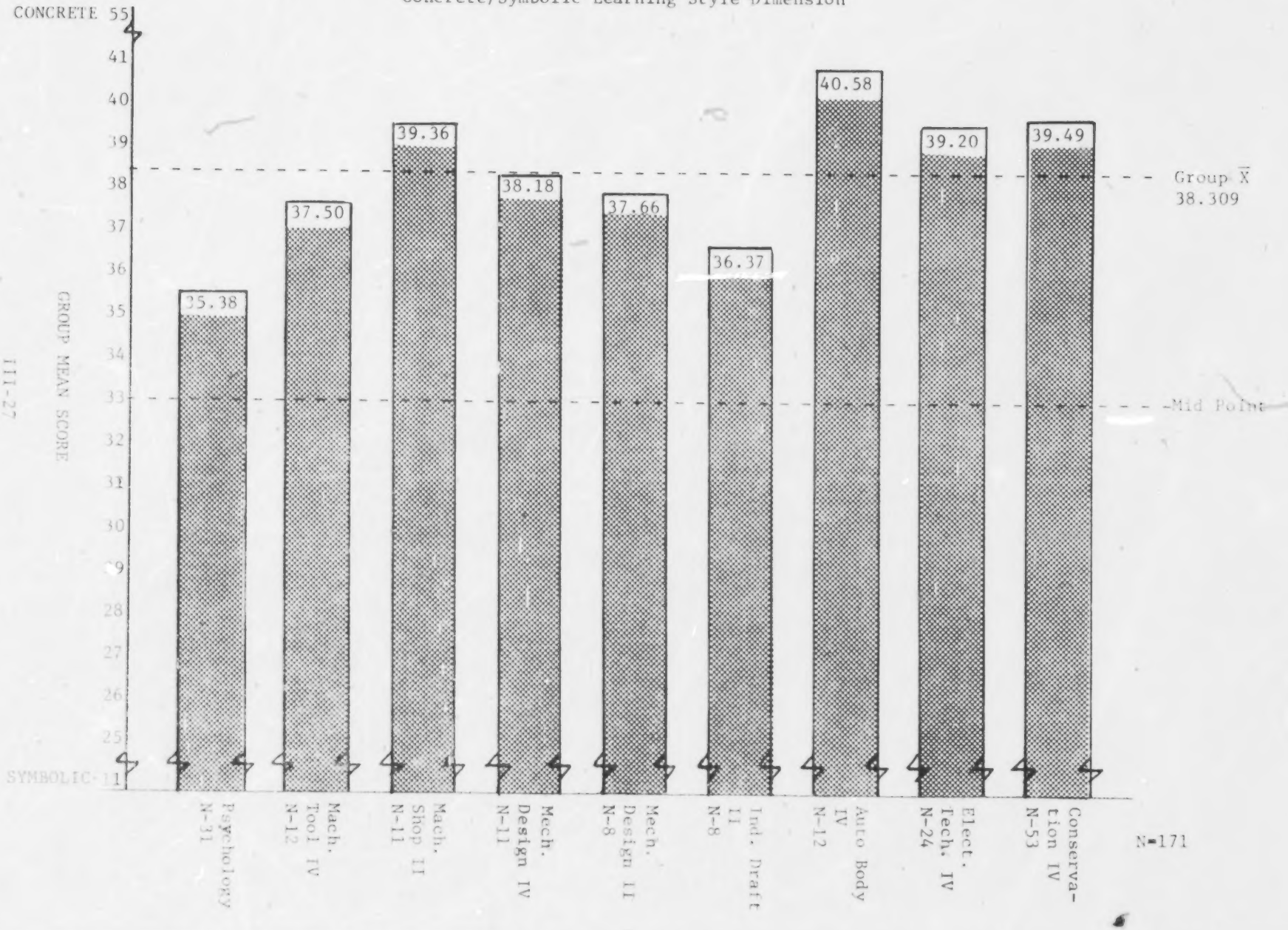


Figure III-10

Comparison of Individual Groups on the
Concrete/Symbolic Learning Style Dimension



The Fox Valley groups beginning with the Machine Tool IV group through the Conservation IV group tended toward the concrete end of the continuum. Four groups had mean scores above the total group mean. Located on the vertical axis is the concrete/symbolic continuum and the height of each bar represents whether the group's mean response tended toward either the concrete or symbolic end. All groups measured including the University of Wisconsin - Stout groups tended toward the concrete end of the scale. The Drawing 500, Machine Shop II, Automobile Body IV, Electronics Technology IV and Conservation IV groups all had individual group mean scores above the total group mean of 38.30. All remaining groups located below the group mean score but above the continuum midpoint of 33.

Analysis of the group means and standard deviations (Table III-12) may aid the individualization of instruction. If individuals choose a program of studies that reinforces their learning styles, they will have fewer conflicts with modes of teaching. If assessment of style is known by the teacher and it appears that there is a wide range of styles within a classroom, alternative forms of instruction can be presented to the individual learner. Individuals may tend to locate at various points along the continuum indicating a strong influence either by the concrete or symbolic style or the need for a mix or a combination of both styles.

A summary of each group's response to individual items on the instrument is contained in Appendix G. Plotting of the individual's placement along both continuums based on the axes formed by the two continuums is found at the end of the Chapter.

Structured/Unstructured Instrument Analysis

An item analysis for the two art groups participating in the final instrumentation is located in Appendix H. Table III-9 shows the item analysis for the final nine groups of participants. Table II-4 indicates a high reliability coefficient (.81) was attained for this section of the instrument. Three items functioned below the .40 level with item 16 indicating a negative correlation with total scores on the scale. Based on the overall reliability, this section of the instrument was a precise measure of the sturctured/unstructured dimension.

Mean scores tend to group around an average response of 3 on each item, indicating that the responders in this study did not prefer extremely structured or unstructured learning environment. If a preference was indicated it would be slightly above the midpoint and tending toward the structured end of the continuum.

Frequency Distribution

The frequency distribution for the art students (Table III-10) indicates they preferred an unstructured learning strategy. Their mean score of 28.49 is considerably below the instrument midpoint of 33 and their range is

Table III-9

FINAL INSTRUMENT ADMINISTRATION TOTAL GROUP ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.005	0.397	0.345	0.192	0.040	0.017	1.929	0.955	0.374	1.125	1.788	2.515	1.390
13	0.000	0.333	0.350	0.251	0.046	0.017	2.064	0.962	0.408	1.250	1.975	2.761	1.511
14	0.000	0.011	0.140	0.444	0.321	0.081	3.321	0.856	0.386	2.720	3.282	3.977	1.256
15	0.000	0.040	0.169	0.368	0.309	0.111	3.280	1.004	0.232	2.607	3.285	4.051	1.444
16	0.000	0.023	0.140	0.210	0.432	0.192	3.631	1.019	-0.123	2.909	3.790	4.368	1.458
17	0.000	0.210	0.298	0.245	0.169	0.076	2.602	1.206	0.633	1.632	2.470	3.482	1.849
18	0.000	0.081	0.263	0.251	0.309	0.093	3.070	1.126	0.646	2.138	3.116	3.995	1.856
19	0.000	0.064	0.233	0.356	0.274	0.070	3.052	1.021	0.663	2.293	3.065	3.845	1.551
20	0.000	0.111	0.286	0.368	0.198	0.035	2.760	1.006	0.601	1.984	2.777	3.456	1.471
21	0.000	0.263	0.333	0.286	0.081	0.035	2.292	1.052	0.572	1.450	2.210	3.035	1.585
22	0.005	0.304	0.368	0.228	0.058	0.035	2.147	1.032	0.564	1.317	2.023	2.820	1.503

from a high structured value of 40 to a low unstructured value of 18. One would hypothesize that individuals engaging in various forms of artistic endeavor would desire an unstructured learning situation. Based on this distribution further analysis would need to be made of those individuals indicating a learning style extremely divergent from the total group.

The frequency distribution for the nine groups at Fox Valley Technical Institute (Table III-11) ranged from a highly structured value of 48 to a highly unstructured score of 22. The mean score value of 34.26 is slightly above the midpoint of the instrument. The group tended to prefer structured learning situations. A large bulk of the individuals would function effectively in either learning style or a composite of the two. Once again it must be emphasized that the information generated by the instruments developed in this study would provide valuable insights into the types of experiences needed for effective learning by all students in a class.

With such a large distribution of values along the continuums, various degrees of strength of the learning styles will influence an individual's learning capacity. An individual achieving a value far above or below the midpoint may be strongly influenced by the learning style designated at that continuum end. A large range of scores denotes the need for alternative learning modes in courses.

Group Comparisons

The graphs in Figures III-11 and III-12 offer a visual comparison of the mean scores for the eleven groups participating in the final instrument administration. Six of the eleven groups attained group means below the midpoint of the continuum. These six groups tended to prefer unstructured learning styles. The means for the remaining groups tended toward the structured end of the continuum with the Mechanical Design II, Automobile Body IV and Electronics Technology IV groups approaching a highly structured style.

The art groups in comparison with the other groups preferred a more unstructured learning style. An evaluation of individual scores would need to be made to determine the number of individual styles in variance with the typical style for the group. If extreme differences existed alternatives would need to be incorporated in the learning strategy to provide all individuals the opportunity to achieve at their maximum learning style capacity.

Table III-12 presents the mean and standard deviation for each group. Recalling that the continuum midpoint is designated as a value of 33 it can be determined that all groups tended toward the concrete continuum end and approached the continuum midpoint on the structured/unstructured continuum. Individuals approaching the midpoint may function effectively utilizing a mixture of learning styles on the continuum or there may be a composite style.

Table III-10

FINAL INSTRUMENT ADMINISTRATION ART GROUP FREQUENCY
DISTRIBUTION STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

```
40  *
39
38
37
36
35  * * * *
34
33 -------Structured/Unstructured Continuum Midpoint
32  * * * * * *
31  *
30
29  *
28  * *
27  *
26
25  * *
24   * *
23  * *
22  * *
21
20  *
19
18  *
```

N = 26 $\bar{X}$ = 28.49

Table III-11

FINAL INSTRUMENT ADMINISTRATION TOTAL GROUP FREQUENCY DISTRIBUTION
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

	Frequency Distribution
48	*
47	
46	* * *
5	*
44	*
43	* *
42	* * * * *
41	* * * * * *
40	* * * * * * * *
39	* * * * * * * * *
38	* * * * * * * * *
37	* * * * * * * * * *
36	* * * * * * * * * * * * * * *
35	* * * * * * * * * * * * * * * * *
34	* * * * * * * * * * * * * * * *
33	* * * * * * * * * * --------Structured/Unstructured Continuum Midpoint
32	* * * * * * * * * *
31	* * * * * * * * * * * * * *
30	* * * * * * * * *
29	* * * * * * * * * * *
28	* * * * *
27	* *

Table III-11 - Continued

26	*
25	* * * * *
24	* *
23	* *
22	*
21	
20	

N = 171 $\bar{X}$ = 34.26

Sd.= 5.17

Figure III-11

Comparison of Art Groups on the
Structured/Unstructured Learning Style Dimension

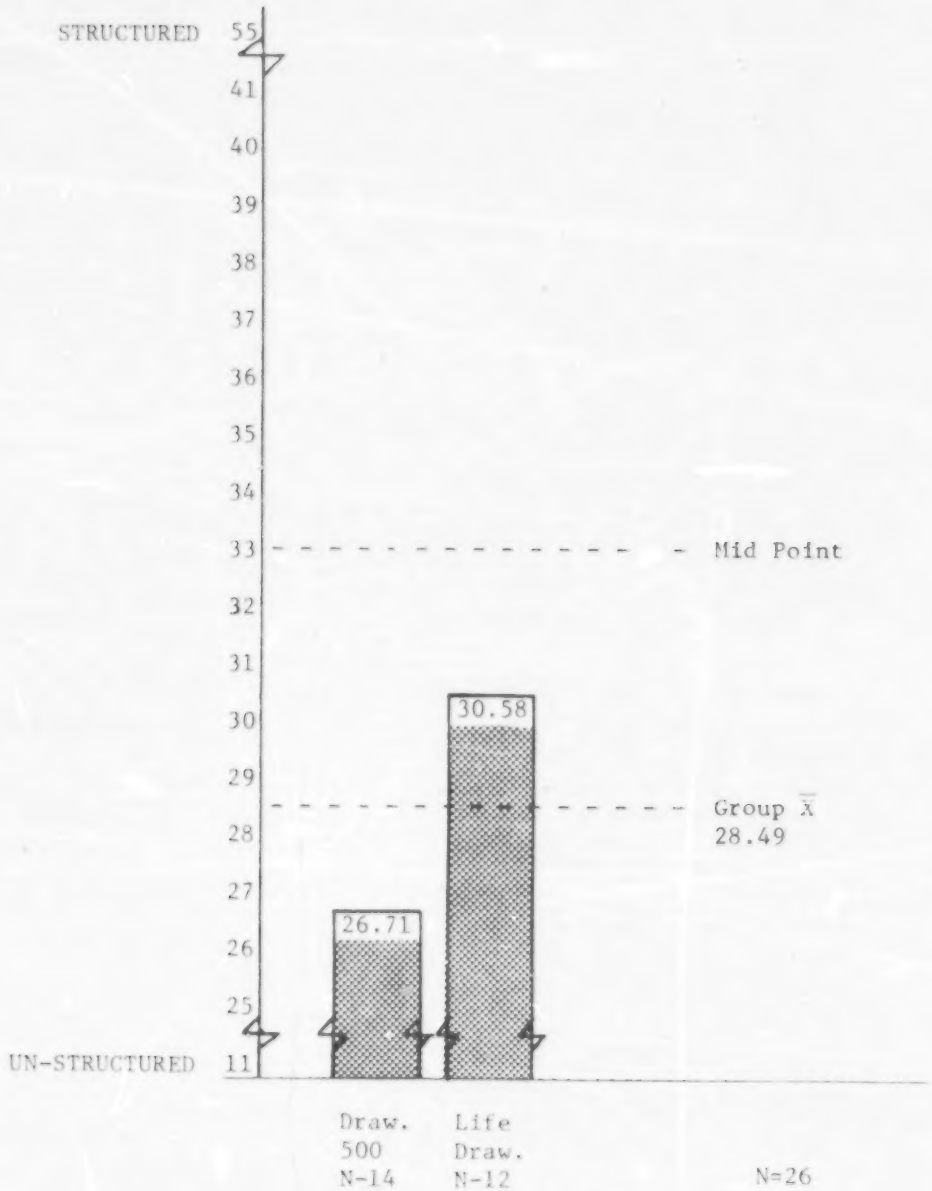


Figure III-12

Comparison of Individual Groups on the
Structured/Unstructured Learning Style Dimension

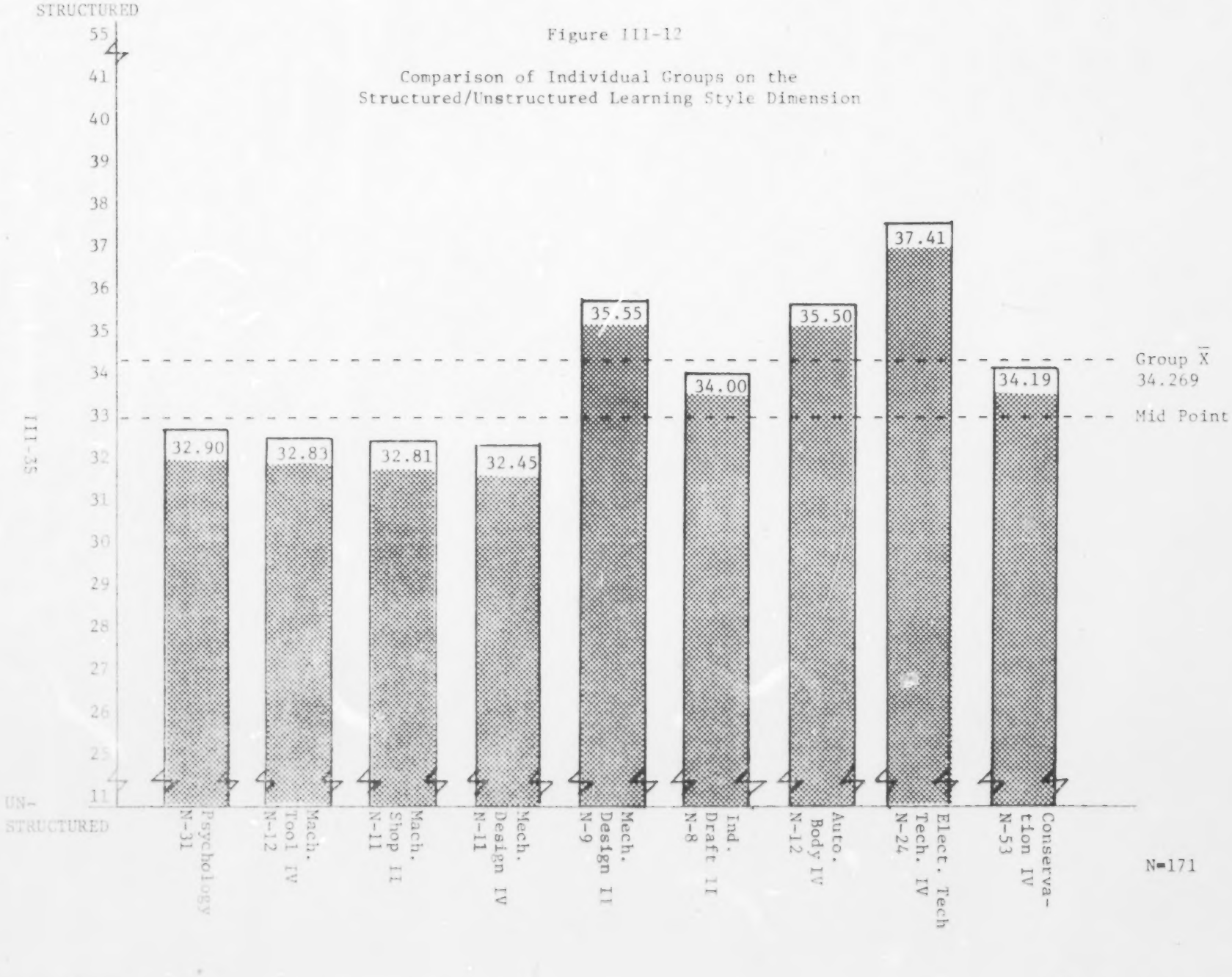


Table III-12

Group Mean and Standard Deviation
Comparison for each Learning Style
Dimension for the Groups Tested

Group	Concrete/ Symbolic	Structured/ Unstructured
Draw. 500		
$\bar{X}$	39.42	26.71
Sd	4.13	5.41
Life Draw.		
$\bar{X}$	37.66	30.58
Sd	2.28	4.73
Psychology		
$\bar{X}$	35.38	32.90
Sd	2.95	5.84
Mach. Tool IV		
$\bar{X}$	37.50	32.83
Sd	2.81	4.81
Mach. Shop II		
$\bar{X}$	39.36	32.81
Sd	1.55	3.45
Mech. Design IV		
$\bar{X}$	38.18	32.45
Sd	3.73	5.10
Mech. Design II		
$\bar{X}$	37.66	35.55
Sd	3.82	5.01
Ind. Draft		
$\bar{X}$	36.37	34.00
Sd	1.49	2.82
Auto. Body		
$\bar{X}$	40.58	35.50
Sd	3.06	4.11
Elect. Tech. IV		
$\bar{X}$	39.20	37.41
Sd	2.67	4.70
Conservation IV		
$\bar{X}$	39.49	34.19
Sd	3.49	5.12
Total Group $\bar{X}$	38.30*	34.26*

*Does not include art group $\bar{X}$ scores

Tables III-13 and III-14 present t-test values for all groups for the concrete/symbolic and structured/unstructured dimensions. In Table III-13 the Psychology and Industrial Drafting II groups account for a majority of the statistically significant differences in learning styles. The symbolic learning style is more evident for these two groups while the concrete style is favored by the other groups. Significant differences in learning style exist between the Machine Tool IV and the Auto Body groups as well as the Machine Shop II and Industrial Drafting group.

Table III-14 indicates statistically significant differences between the Electronics Technology IV group and five of the eight remaining groups. A stronger preference for a structured style of learning is evident in the Electronics Technology group than in the other five groups.

Based on these data it appears that the instruments were sensitive enough to detect differences in learning styles between various programs and that the instruments developed provided a valid measure for identifying learning styles.

Plottings

The two scores an individual achieves on the two continuums can be plotted graphically along two axes. The concrete/symbolic continuum is placed along the horizontal "X" axis and the vertical "Y" axis is formed by the structured/unstructured continuum. Figures III-13 to III-23 provide plots for all participants by group based on their major program of study. Figure III-24 shows the total group plot based on the continuums investigated.

The plot of the Mechanical Design IV group shown in Figure III-18 will provide an interpretation of the concept. The group is composed of 11 individuals located at various points on the plot. The intersect of their concrete/symbolic continuum scores with their structured/unstructured continuum scores determines the plot location. Six of the eleven locate near the midpoint of the structured/unstructured continuum. The other 5 locate at points tending toward one or the other of the continuums end points. Based on this knowledge and an understanding of the means and standard deviations it can be visually interpreted that some individuals within the group show indications of desiring either a structured or unstructured learning style. The group mean of 32.45 indicates the group desires a mix or composite of learning styles. Based on the plot alternatives of the group it indicates that alternative modes of instruction should be provided.

Ten of the 11 group members locate near the mean of 38.18 on the concrete/symbolic continuum. One individual is located nearly 2 standard deviations above the group mean, indicating a tendency toward the strongly concrete continuum end. This individual shows a high concrete/unstructured combination of learning styles. The total group shows a concrete/

Table III-13

T-test on Means for the
Concrete/Symbolic Continuum

	Psychology	Machine Tool IV	Machine Shop II	Mechanical Design IV	Mechanical Design II	Industrial Drafting II	Automobile Body IV	Electronics Technology IV	Conservation IV
Psychology		2.07*	4.15*	2.44*	1.84	.89	4.99*	4.85*	5.41*
Machine Tool IV			1.85	.47	.10	.98	2.45*	1.72	1.81
Machine Shop II				.92	1.27	3.97*	1.13	.17	.11
Mechanical Design IV					.28	1.22	1.61	.89	1.09
Mechanical Design II						.84	1.84	1.25	1.40
Industrial Drafting II							3.42*	2.75*	2.28*
Automobile Body IV								1.34	1.31
Electronics Technology IV									.05
Conservation IV									

* $p \leq .05$

Table III-14

T-test on Means for the
Structured/Unstructured Continuum

	Psychology	Machine Tool IV	Machine Shop II	Mechanical Design IV	Mechanical Design II	Industrial Drafting II	Automobile Body IV	Electronics Technology IV	Conservation IV
Psychology		.03	.04	.22	1.20	.50	1.37	3.03*	1.04
Machine Tool IV			.00	.17	1.19	.58	1.39	2.65*	.82
Machine Shop II				.18	1.36	.74	1.60	2.81*	.83
Mechanical Design IV					1.29	.73	1.51	2.73*	1.00
Mechanical Design II						.72	.02	.96	.73
Industrial Drafting II							.85	1.87	.21
Automobile Body IV								1.16	.71
Electronics Technology IV									2.48*
Conservation IV									

* $p < .05$

Figure III-13

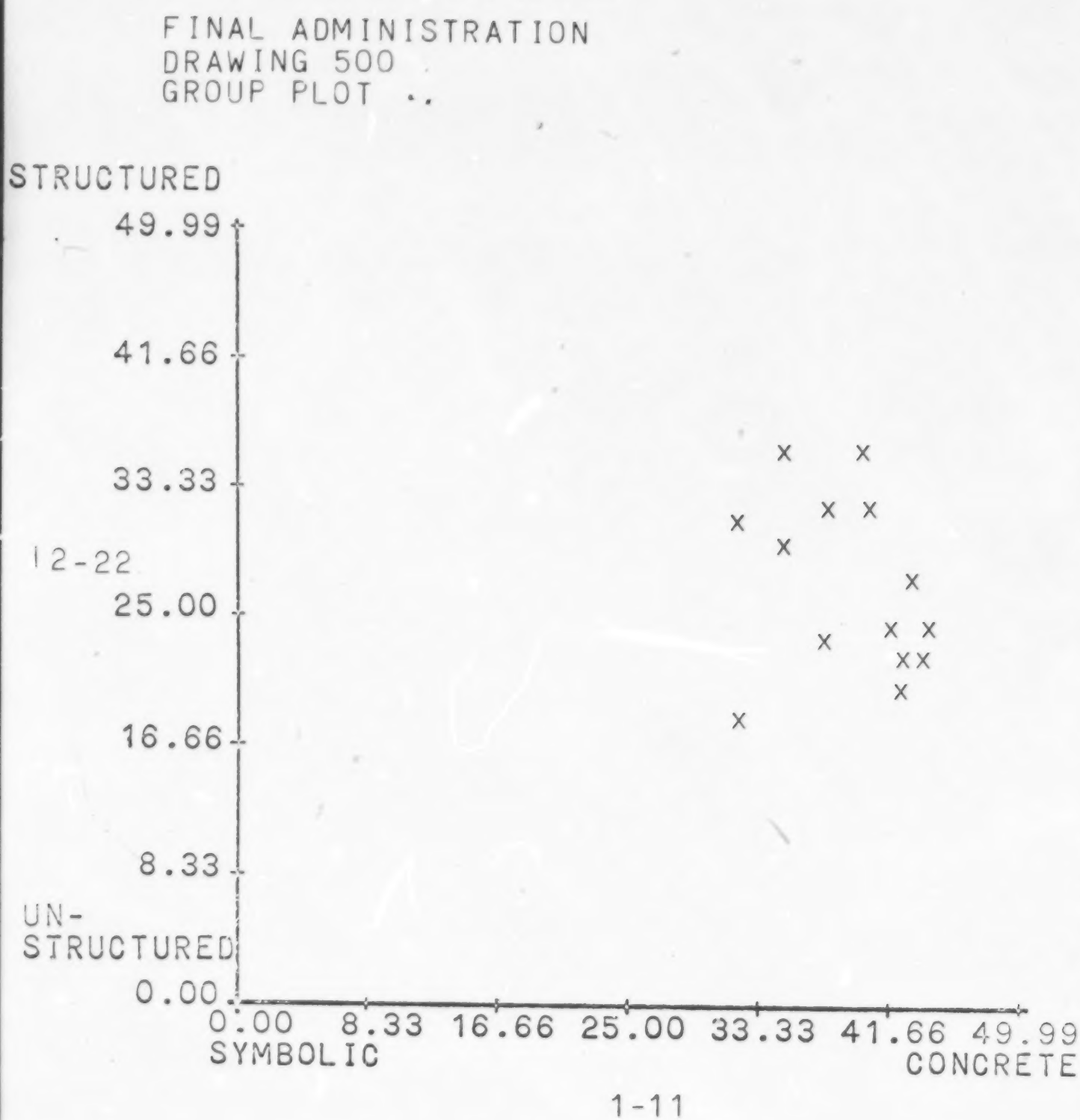
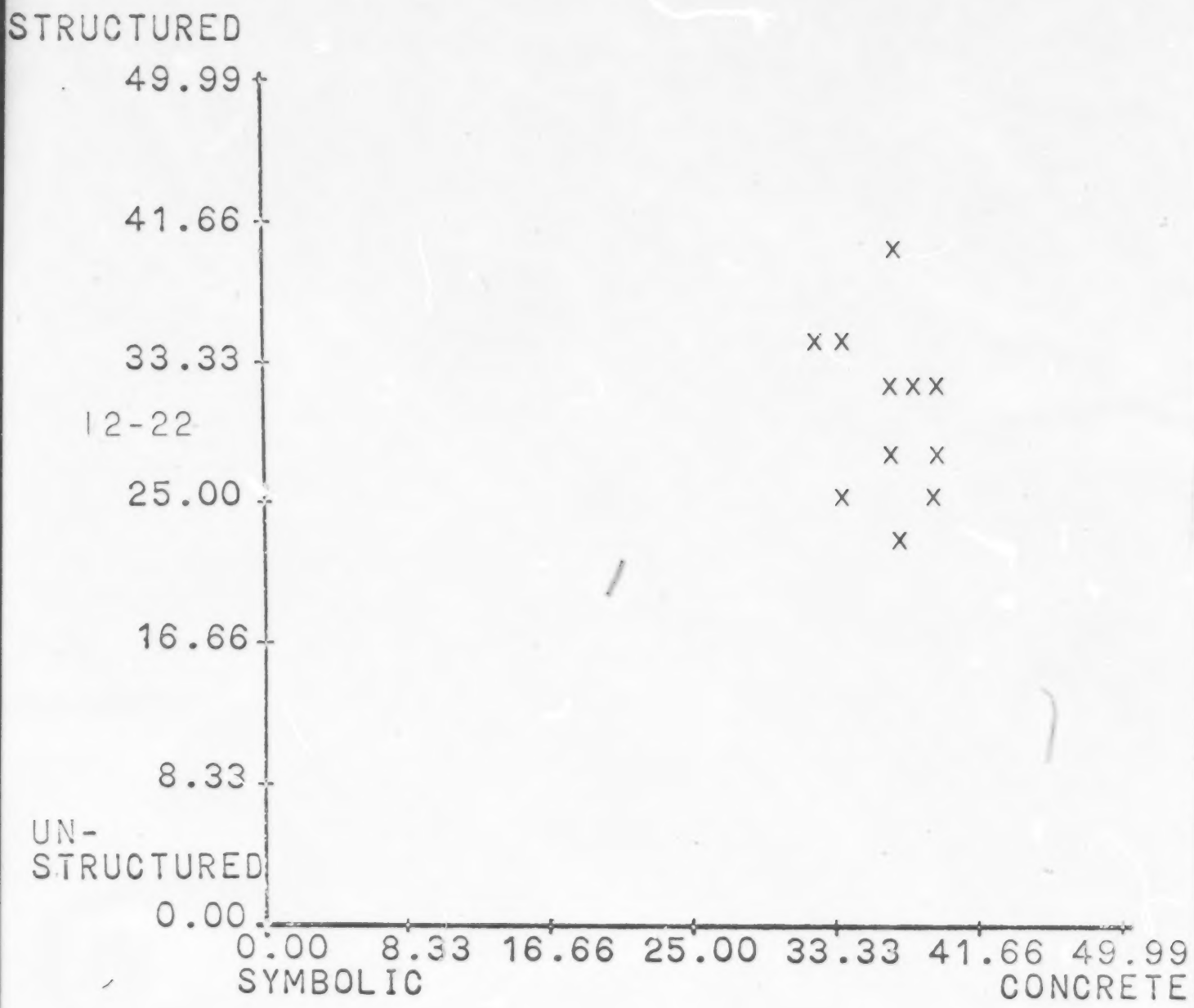


Figure III-14

FINAL ADMINISTRATION
LIFE DRAWING
GROUP PLOT



1-11

Figure III-15

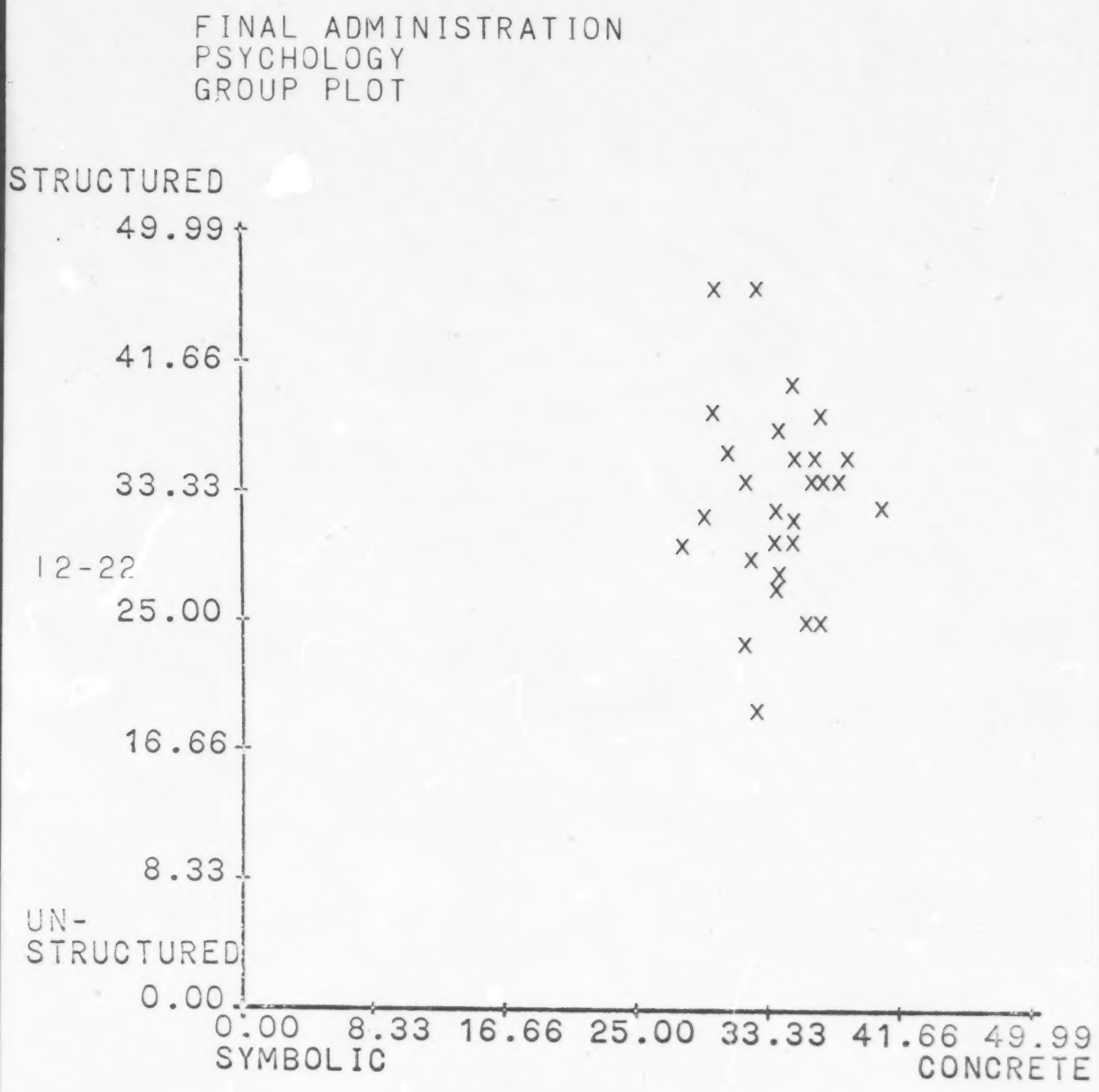
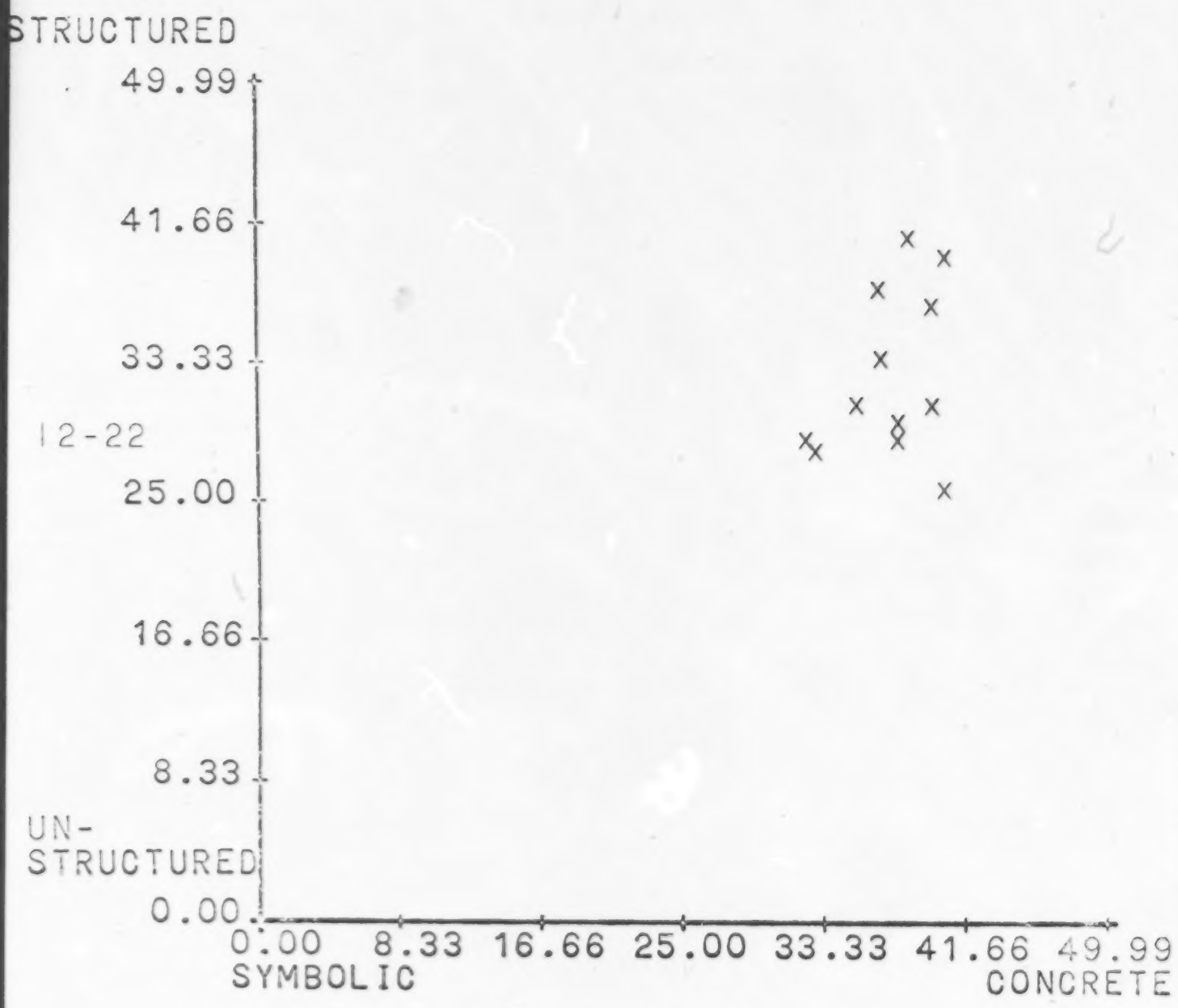


Figure III-16

FINAL ADMINISTRATION
MACHINE TOOL IV
GROUP PLOT



1-11

Figure III-17

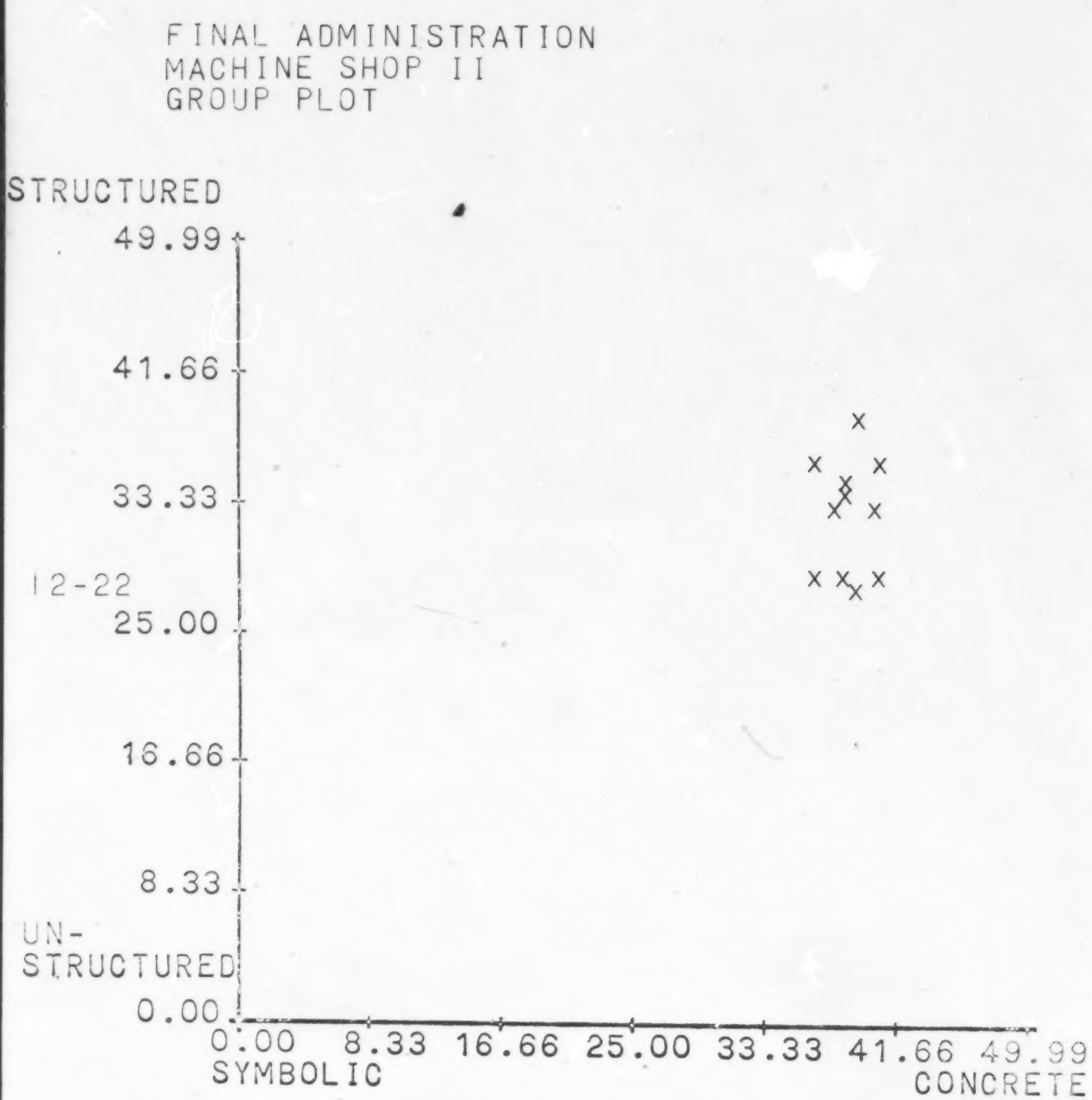


Figure III-18

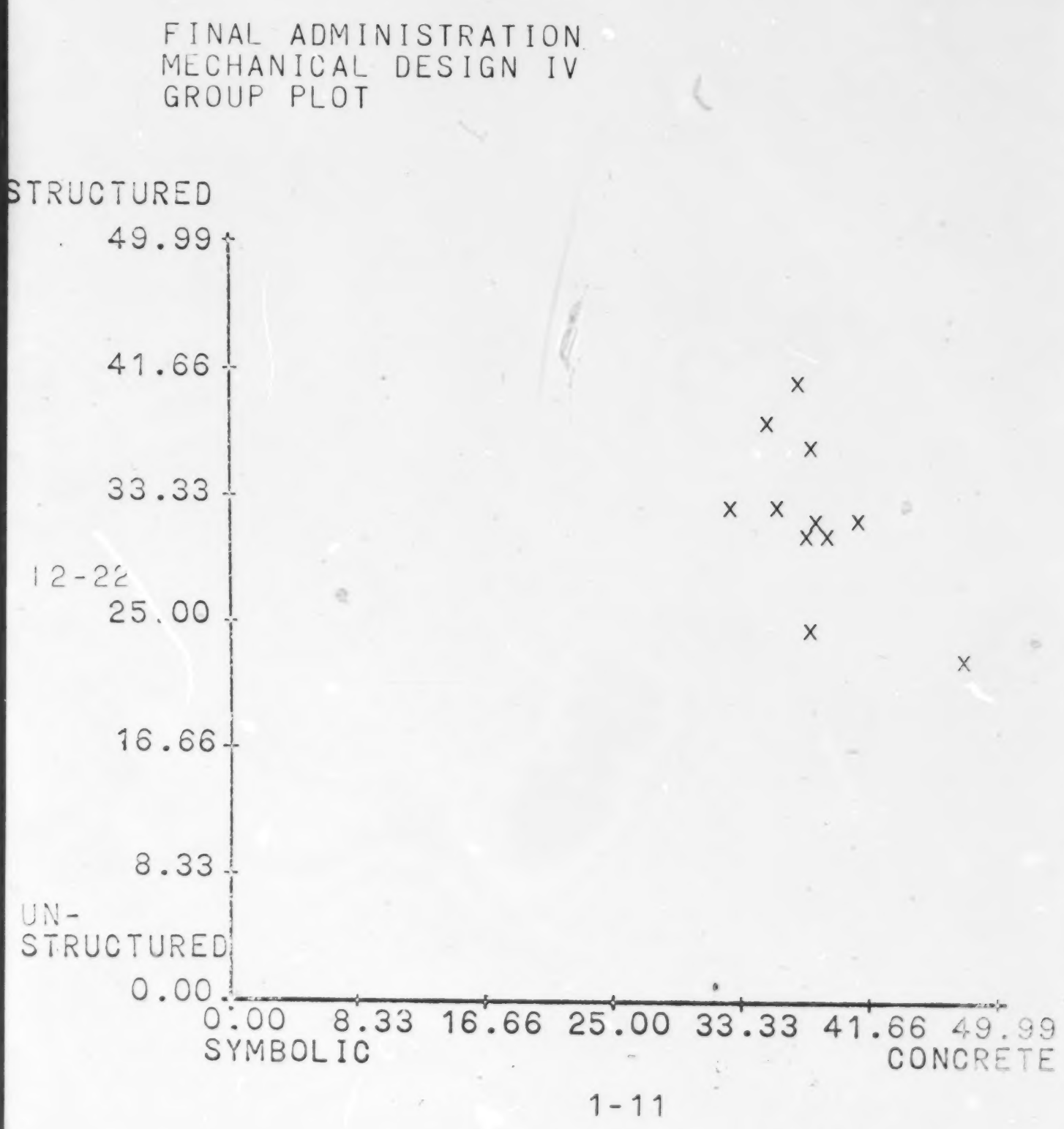
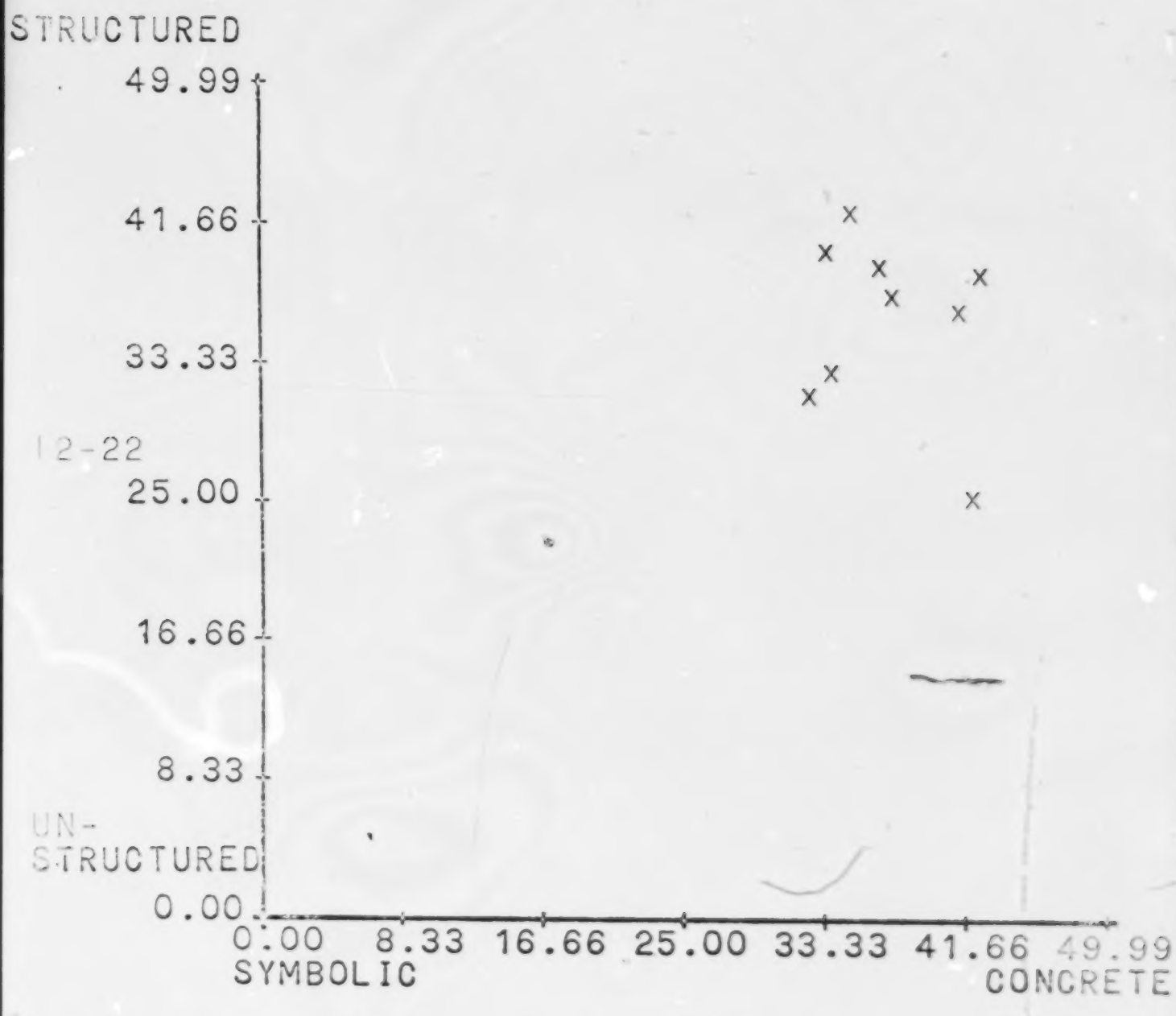


Figure III-19

FINAL ADMINISTRATION
MECHANICAL DESIGN II
GROUP PLOT



1-11

Figure III-20

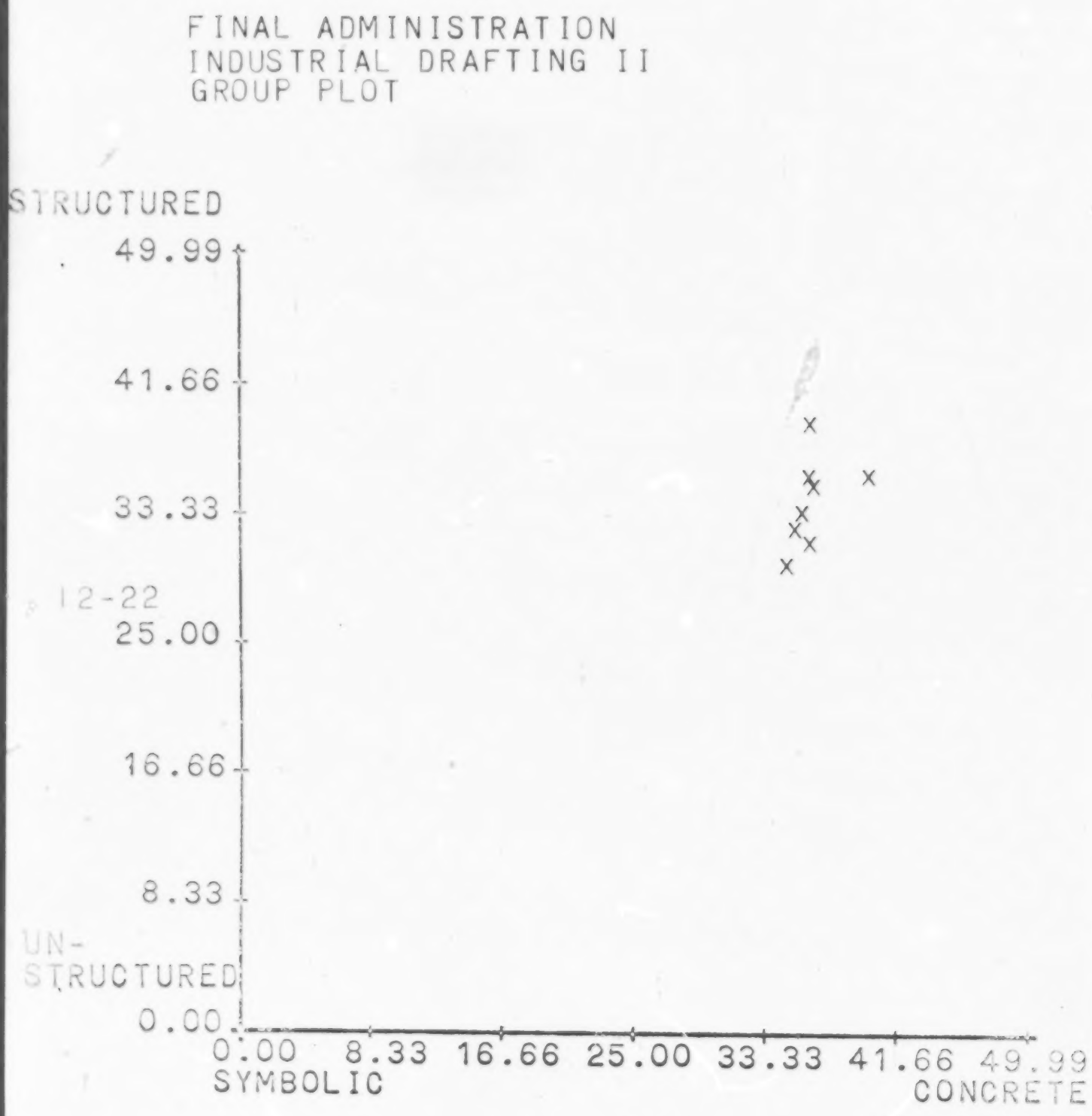
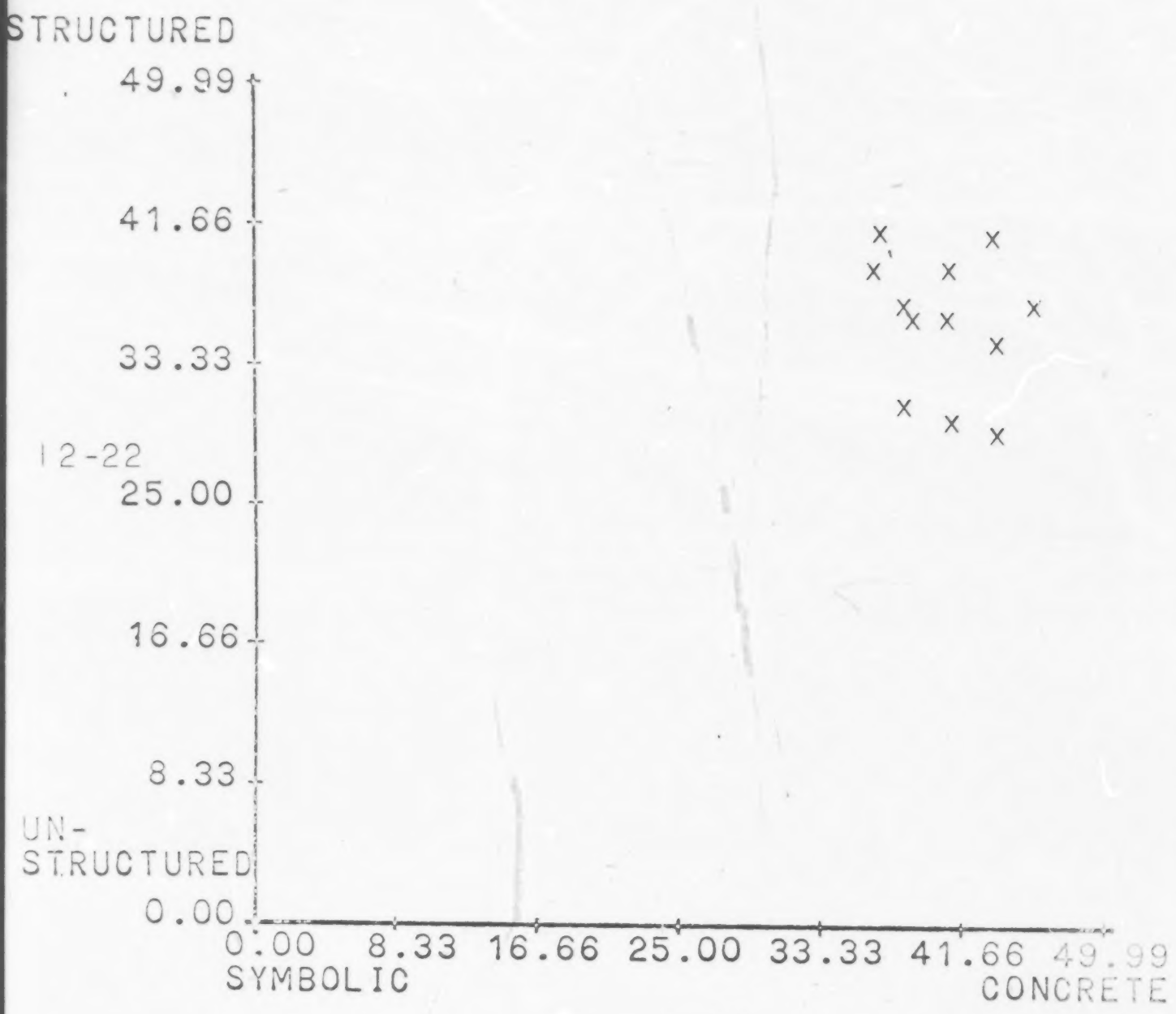


Figure III-21

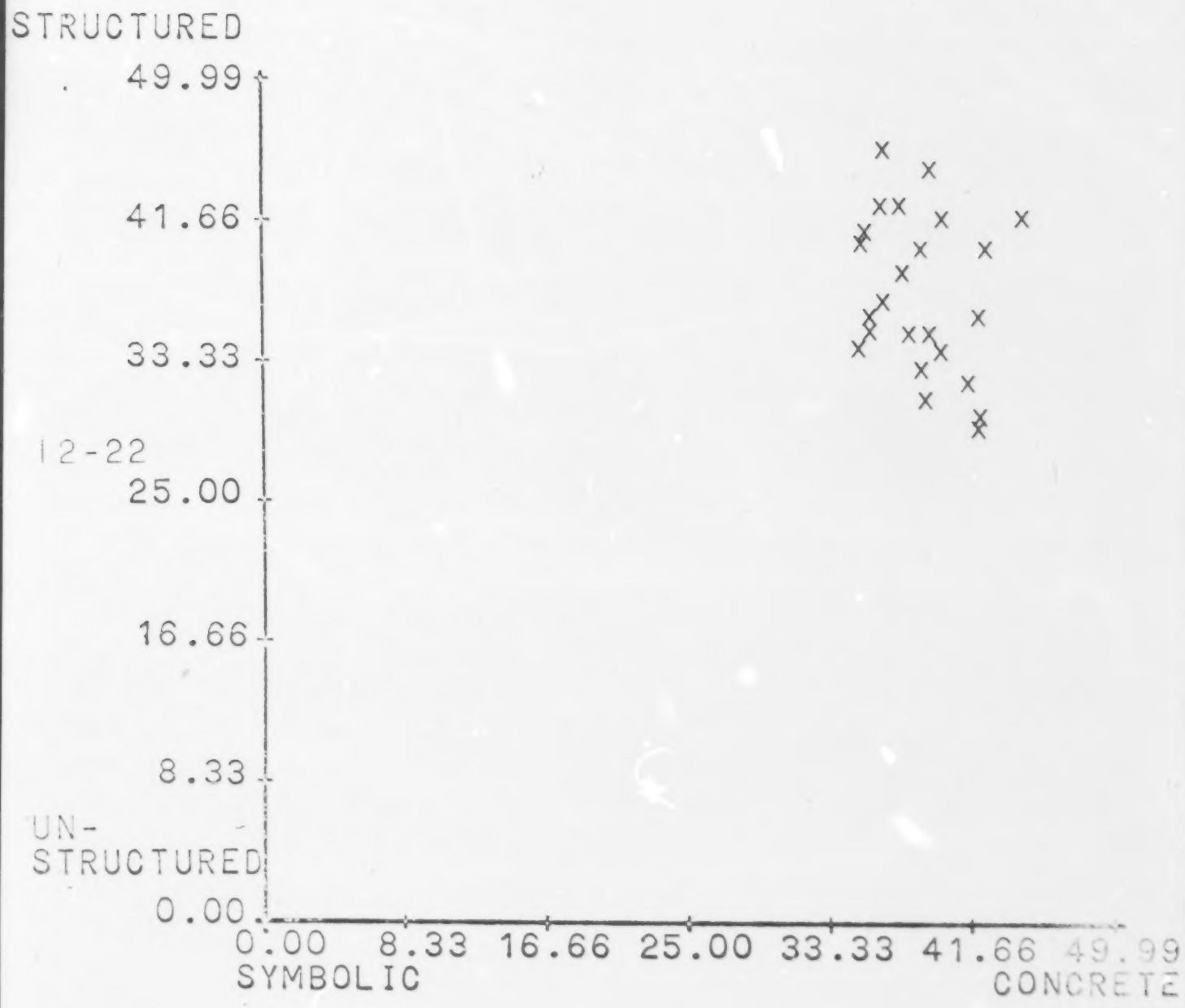
FINAL ADMINISTRATION
AUTO BODY IV
GROUP PLOT



1-11

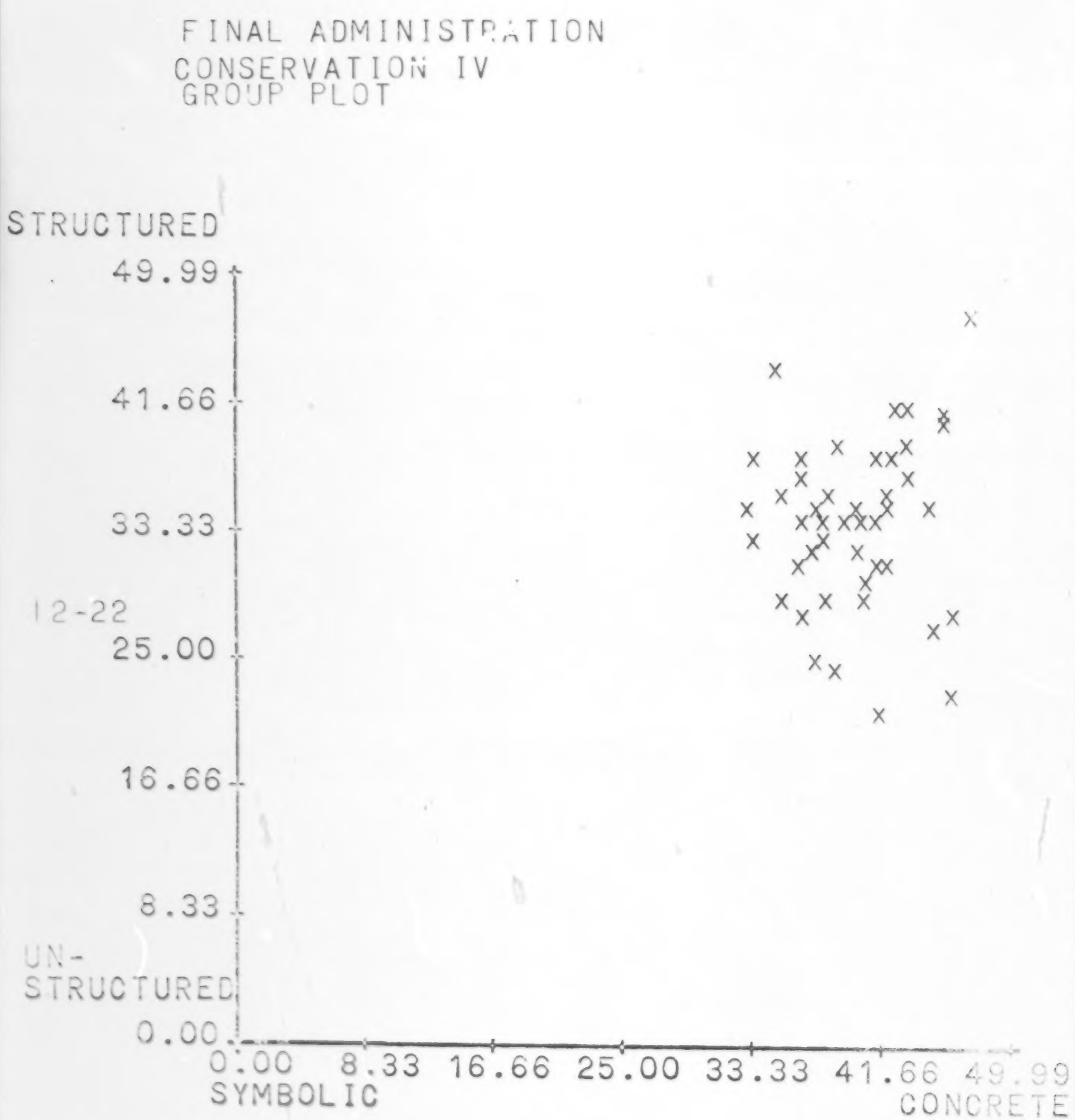
Figure III-22

FINAL ADMINISTRATION
ELECTRONICS TECHNOLOGY IV
GROUP PLOT



1-11

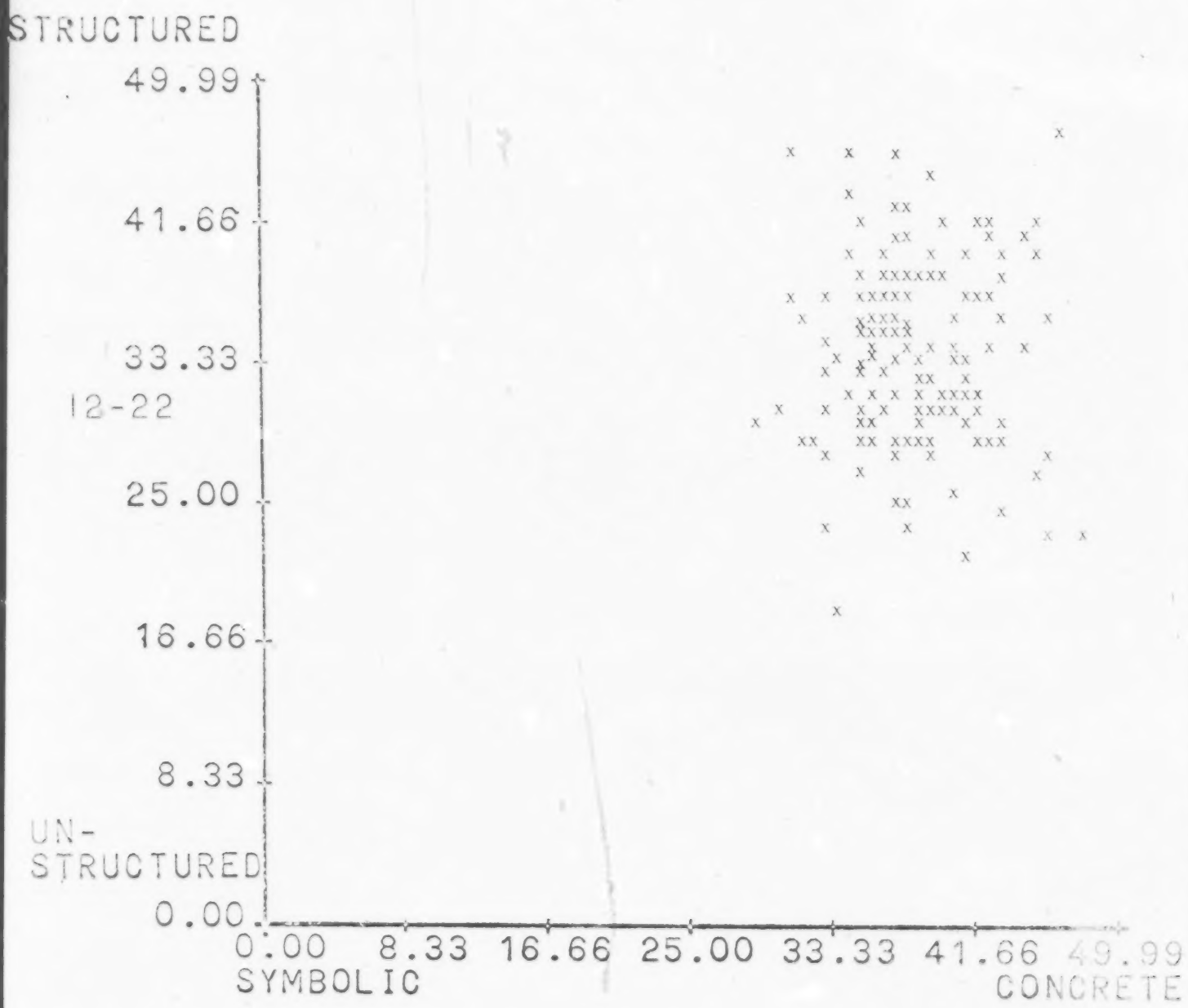
Figure III-23



1-11

Figure III-24

FINAL ADMINISTRATION
TOTAL
GROUP PLOT



1-11

structured/unstructured mix of learning styles. The plots therefore visually show the continuum locations of each individual and provide information essential in individualizing a program of instruction.

The plot for an individual provides a teacher with information on the relationship of each individual student's concrete/symbolic and structured/unstructured learning styles with those of his peers. The majority of all students encompassed in the study scored in the structured and concrete area. A few individuals in each program are located outside of this area. Hence, consideration should be given to providing alternative modes of instruction for them.

Interpretation of the plots for individual groups provides valuable insight into the learning styles of the individuals in each group. If extreme plots are evident or a minority of students do not locate within close proximity to the other members of the class, alternatives in instruction may need to be provided. Also, the plot provides a visual display of the level of the two learning styles which can be quickly interpreted by the teacher.

Computer Program Development

The weighted scores analysis program (Appendix D) was developed for this study. This program weighs responses to Likert type items and generates the item analysis displayed in this Chapter. A computer program to store and contrast assorted learning style and program variables for individual learners was proposed and the initial development was undertaken. The program was discontinued when Fox Valley Technical Institute contemplated the possibility of implementing some form of Oakland Community College's Cognitive Style Mapping developed by Dr. Joseph E. Hill.

Learning Styles and Class Performance

A comparison of the performance in a symbolic class of eight highly concrete students with eight highly symbolic students is shown in Table III-15. The eight students preferring a highly concrete learning style provide a continuum mean of 46 while the eight highly symbolic students continuum placement mean was 33. No Fox Valley students placed lower than the midpoint of 33 on the continuum scale.

Table III-15

Relationship Between Class Performance and Learning Styles

Style	N	Continuum $\bar{X}$	Cum. GPA $\bar{X}$	Cum. GPA sd.	Math GPA $\bar{X}$	Math GPA sd.
Concrete	8	46	2.82	.633	2.85	1.19
Symbolic	8	33	2.83	.293	3.14	.904

Although there was considerable difference in the concrete/symbolic scores between groups the cummulative grade point for the two groups was nearly identical. The concrete students GPA was 2.82 while the GPA of the symbolic students was 2.83.

All students are required to complete either applied or technical mathematics. A comparison was made between the two groups for the grade averages they attained in the mathematics classes. Based on the grade point averages a difference in math scores is noted between the most highly concrete and most highly symbolic. The concrete students' grade average in mathematics is 2.85 and the symbolic students average is 3.14. Highly concrete students do not do as well as symbolic students in a symbolic instructional strategy such as mathematics. It must be pointed out that other variables may exist, but an interesting implication is evident. The difference between the two means were not statistically significant.

There appears to be some relationship between the student's performance in class and learning styles. Learning styles appear to affect a student's success on other measures divergent from the student's learning style. Further research could be conducted to validate this implication.

Summary

An instrument was developed in the study to measure two separate and distinct learning style variables. An individual is influenced by a concrete/symbolic continuum and a structured/unstructured continuum. The placement somewhere along the continuum indicates the preference for a specific style. The placement of the individual somewhere near the continuum midpoint may indicate that the individual desires a mix or composite of both of the learning styles on the continuum.

The differences between the mean scores for the programs included in the study suggest that the instrument is valid. Validity was determined by a content and concurrent process. Programs with a larger loading of concrete learning experiences attracted students with more concrete scores. Similar results were obtained for the structured/unstructured scale.

The variance of scores within groups suggests the need for offering alternative learning and teaching modes within classes and programs. Individuals placing at the extreme ends of a continuum may be placed in a conflict situation if one instructional mode is employed. True individualization of instruction will consider all variables of the learner and provision can be made to provide the learner with optimum learning conditions.

Conclusions

Based on information collected and presented it appears that an individual's learning style can be determined. As the study indicates four

learning styles were investigated and placed on two continuum scales. The continuum scales reflecting the styles were designated as concrete/symbolic and structured/unstructured learning style continuums. The responders in the study indicated a slight preference for the concrete style of learning and were at the continuum midpoint for the structured/unstructured learning style.

In the first Chapter it was pointed out that other learning styles exist as well as other learner variables. No attempt is made to imply that the variables investigated in this study are the only significant ones. When dealing with individuals and their learning characteristics many variables are involved. Among these variables is learning style. The essential result from the study is a belief that learning style is a measurable and definite variable as it relates to effective and efficient learning.

If an individual teacher is honestly attempting to individualize his program, learning styles will be an important consideration. Methods and innovations must be researched which will enable the largest possible number of individuals to achieve to their fullest capacity.

If learning styles are assessed and determined, educators must develop the strategies to compliment the various styles in order to achieve optimum learning development. And if no attempt to optimize strategies to compliment learning styles is made, at least an awareness of their existence is a step forward toward an improved learning environment.

Steps should now be taken to identify maximum instructional strategies and design characteristics for instructional materials which are appropriate for various levels of concrete/symbolic and structured/unstructured learning styles.

CHAPTER IV

RECOMMENDATIONS

Learning style has been determined to be a measurable learner variable, based on the dimensions investigated in the study. If the assessment of learning style is to have an educational impact the following recommendations are made:

1. Continue the investigation of learning styles and its interaction with other learner variables.

2. Expand the four style variables investigated in this study to include other possible styles applicable to vocational-technical situations.

3. Devise further instrumentation to measure learning styles in ways other than a pencil and paper instrument.

4. Make necessary revisions in the concrete/symbolic continuum to improve instrument reliability.

5. Conduct instrument administrations outside of an individual's classroom, possibly before an individual actually engages in class participation.

6. Attempt to eliminate assorted variables functioning within the item by revising selected statements to make them more specific.

7. Attempt to offer alternative opportunities to individuals with differing learning styles.

8. Conduct further evaluation with a control group of students to determine if learning style affects their rate of comprehension, success within various courses offering divergent teaching styles, and completion and dropout rate within a specified period of time.

9. Accumulate various learner variables within a computer system to aid in programming individuals in learning experiences that provide for optimum learner achievement.

10. Inform classroom teachers of the availability of material and evaluation techniques in the area of learning styles and aid them in implementing such a program.

11. Individualize programs to reflect various learning style variables functioning within the participating individuals.

12. Keep in mind that learning style is not an absolute dimension, it is subject to change and alteration as an individual changes throughout a lifetime and may interact with the content to be learned.

Learning Styles Bibliography

BALDWIN, A.L. Theories of child development. New York: John Wiley & Son's, 1967.

BECKER, J., DOCTOR, R.M., MIRANDA, M. & WALLACE, J. Analytic-perceptual style and verbal conditioning. Perceptual and motor skills, 1971, 32, 631-636.

BESWICK, D.G. & TALLMADGE, G.K. Reexamination of two learning styles studies in the light of the cognitive process theory of curiosity. Journal of educational psychology, 1971, 62, 456-462.

BIGGE, M.L. Learning theories for teachers. New York: Harper & Row, 1964.

BRUNER, J.S. Toward a theory of instruction. Cambridge: The Harvard University Press, 1966.

BRUNER, J.S. The process of education. Cambridge: Harvard University Press, 1961.

BRUNER, J.S. On cognitive growth II. In Bruner, J.S., Oliver, R. & Greenfield, P. Studies in cognitive growth. New York: John Wiley, 1966.

BRUNER, J.S., GOODNOW, J.J. & AUSTIN, G.A. A study of thinking. New York: John Wiley & Sons, 1965.

BUGELSKI, B.R. The psychology of learning. New York: Holt, Rinehart & Winston, 1956.

BUGELSKI, B.R. The psychology of learning applied to teaching. Indianapolis: The Bobs-Merrill Co., 1971.

BYRAM, C.A., & LARSON, R. (eds.) Teaching in IPI. Philadelphia: Research for Better Schools, 1972.

COOP, R.H. & SIGEL, I.E. Cognitive style: Implications for learning and instruction. Psychology in the schools, 1971, 8, 152-162.

COOP, R.H. & BROWN, L.D. The effects of cognitive style & teaching method on categories of achievement. The American psychological association. Issue No. 7 (The Experimental Publication System), 1970, 1-8.

CORWIN, R. Discovery boxes. Educational technology, 1972, 12.

DAVIS, A.J. Cognitive style: Methodological & developmental considerations. Child development, 1971, 42, 1447-59.

DAVIS, A.J. & KLAUSMEIER, H.J. Cognitive style & concept identification as a function of complexity and training procedures. Journal of educational psychology, 1970, 61, 423-30.

DeCECCO, J.P. The psychology of learning and instruction. Englewood Cliffs: Prentice-Hall, 1968.

DUNN R. & DUNN, K. Practical approaches to individualizing instruction: Contracts and other effective teaching strategies. West Nyack: Parker Publishing, 1972.

FREDERICK, W.C. & KLAUSMEIER, H.J. Cognitive styles: A description. Educational leadership, 1970, 27, 668-72.

GAGNE, R.M. The conditions of learning. 2nd. Ed. New York: Holt, Rinehart & Winston, 1970.

GARRETTSON, J. Cognitive style & classification. The journal of genetic psychology, 1971, 119, 79-87.

GILLIES, J. & BAUER, R. Cognitive style & perception of success of failure. Perceptual and motor skills, 1971, 33, 839-42.

GLASER, R. Individuals & learning: The new aptitudes. Education research, June, 1972, 5-13.

GUILFORD, J.P. American psychologist, 1959, 14, 464-79.

GUILFORD, J.P. Intelligence: 1965 model. American psychologist, 1966, 21, 20-26.

HESTER, R.M. & TAGATZ G.E. The effects of cognitive style and instructional strategy on concept attainment. The journal of general psychology, 1971, 85, 229-37.

HILGARD, E.R. Theories of learning. New York: Appleton Century-Crofts, 1956.

HILL, J.E. & NUNNEY, D.N. Career mobility through personalized occupational education. American vocational journal, 1971, 46, 36-9. (a)

HILL, J.E. & NUNNEY, D.N. Personalizing educational programs utilizing cognitive style mapping. Progress report at Oakland Community College, Michigan, 1971. (b)

HOLLAND, J.L. The psychology of vocational choice. Waltham, Mass.: Blaisdell, 1966.

JENSEN, A.R. Individual differences in visual & auditory memory. Journal of educational psychology, 1971, 62, 123-31.

JOHANSSON, C.B. Cognitive interest styles of students. Measurement and evaluation in guidance, 1971, IV, 176-83.

KAGAN, J., MOSS, H.A. & SIGEL, I.E. The psychological significance of styles of conceptualization. In J.F. Wright and J. Kagan (Eds.) Basic cognitive processes in children. Monograph of the society for research in child development, 1963, 28, 73-112.

KAGAN, J. Reflection-impulsivity: the generality & dynamics of conceptual tempo. Journal of abnormal psychology, 1966, 71, 17-22.

KAGAN, J., MOSS, H.A. & SIGEL, I.E. Conceptual style & the use of affect lables. Merrill-Palmer quarterly, 1960, 6, 261-78

KLAUSMEIER, H.J. & RIPPLE, R.E. Learning & human abilities. New York: Harper & Row, 1971.

KROGSTAD, ROLAND J. Preliminary consideration in the development of studies of the interactions of individual learning styles with components of individualized instruction in vocational, technical and audlt education. Xeroxed. Madison, Wi. Research Coordinating Unit, Dec., 1972.

LOVAAS, O.I. Interaction between verbal & nonverbal behavior. Child development, 1961, 329-36.

MARZOCCO, F.N., DAVIS, R.H. & DENNY, M.R. Interaction of individual differences with modes of presenting programmed instruction. Journal of educational psychology, 1970, 61, 198-204.

McCLOSKY, M.G. Teaching strategies & classroom realities. Englewood Cliffs: Prentice-Hall, 1971.

OLIVER, R. & HORNSBY, J. On equivalance. In Bruner, Oliver and Greenfield, Studies in cognitive growth. New York: John Wiley, 1966.

OSIPOW, S.H. Cognitive styles and educational-vocational preferences and selection. Journal of counseling psychology, 1969, 16, 534-46.

PENK, W.E. Developmental patterns of conceptual styles. Psychological reports, 1971, 29, 635-49.

RIPPLE, R.E. Readings in learning and human abilities. New York: Harper and Row, 1964.

ROSENBERG, M.B. Diagnostic teaching. Seattle: Special Child Publications, 1968.

ROSENSTEIN, J. Concept development and language instruction of the deaf. Exceptional children, 1964, 30, 337-43.

SCANLON, R.G. Progress report. Philadelphia: Research for better schools, 1972.

SIEGEL, L. & SIEGEL, L. Educational set: A determinant of acquisition. Journal of educational psychology, 1965, 56, 1-12.

SHOUKSMITH, G. Personality attributes associated with two measures of cognitive style. Acta psychology, 1969, 31, 353-64.

SLATTERLY, D.J. & BRIMER, M.A. Cognitive styles and school learning. The British journal of educational psychology, 1971, 41, 294-303.

SOCIETY FOR RESEARCH IN CHILD DEVELOPMENT, THE Cognitive development in children. Chicago: The University of Chicago Press, 1970. Five monographs of the society.

SUCHMAN, J.R. Inquiry training: Building skills for autonomous discovery. Merrill-Palmer quarterly, 1961, 7, 147-69.

TABA, H., LEVINE, S. & ELZEY, F.F. Thinking in elementary school children. San Francisco: San Francisco State College, 1964.

TALLMADGE, G.K. & SHEARER, J.W. Relationships among learning styles, instructional methods, & the nature of learning experiences. Journal of educational psychology, 1969, 60, 222-230.

TALLMADGE, G.K. & SHEARER, J.W. Interactive relationships among learner characteristics, types of learning, instructional methods, and subject matter variables. Journal of educational psychology, 1971, 62, 31-38.

WADSWORTH, B.J. Piaget's theory of cognitive development. New York: David McKay, 1971.

WEPMAN, J.M. Auditory discrimination, speech & reading. Elementary school journal, 1960, 60, 333-375.

WITKIN, H.A., DYK, R.B., FATERSON, H.F., GOODENOUGH, D.R. & KARP, S.A. Psychological differentiation. New York: Wiley, 1962.

WINEMAN, J.H. Cognitive style & reading ability. California journal of educational research, 1971, 22, 74-9.

YANDO, R.M. & KAGAN, J. The effect of teacher tempo on the child. Child development, 1968, 39, 27-34.

Appendix A

Pilot Semantic Differential Instrument

Program_____ Major_____ Name_____

Sex (M - F)
(circle one)

Date_____ Class_____

Age_____

LEARNING STYLES EVALUATION FORM

The writer would like to know what you think and how you feel about various learning situations. You can help by completing the graphic rating scale presented below. Please make your judgements on the basis of what these things mean to you. You are to rate the opposing adjectives on each of the scales as follows:

If you feel that the question is very closely related to one end of the scale, you should place your check-mark as follows:

difficult __X__ : ____ : ____ : ____ : ____ : ____ : ____ easy

or

difficult ____ : ____ : ____ : ____ : ____ : ____ : X ____ easy

If you feel that the question is quite closely related to one or the other end of the scale (but not extremely), you should place your check-mark as follows:

difficult ____ : X : ____ : ____ : ____ : ____ : ____ easy

or

difficult ____ : ____ : ____ : ____ : ____ : X : ____ easy

If you feel that the question is only slightly related to one side as opposed to the other side (but not really neutral), you should then place your check-mark as follows:

difficult ____ : ____ : X : ____ : ____ : ____ : ____ easy

or

difficult ____ : ____ : ____ : ____ : X : ____ : ____ easy

The direction toward which you check, of course, depends upon which of the two ends of the scale seem most characteristic to you of the question that you are evaluating.

If you consider the question to be neutral on the scale, both sides of the scale equally associated with the question, or if the question is completely irrelevant (unrelated to the question), then you should place your check-mark in the middle of the space as follows:

difficult ____ : ____ : ____ : X : ____ : ____ : ____ easy

IMPORTANT: a. Place your check-marks in the middle of the spaces provided, not on the boundaries.

difficult ____ : ____ : X : ____ : X ____ : ____ easy

THIS NOT THIS

b. Be sure to mark every scale for every question--do not omit any.

c. Never put more than one check-mark on a single scale.

STUDENT REACTION TO LEARNING ACTIVITIES

1. Classes that allow me to work with tools, materials and equipment are:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

2. A learning situation that allows me to get involved with fellow classmates in group work is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

3. I find that shop and laboratory classes are:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

4. I find that classes that allow me to use tools, objects, etc. are:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

5. Classes that teach me skills or job competancies are:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

6. Instruction that requires me to do a great deal of reading is:

		1	2	3	4	5	6	7	
a.	difficult	_____	_____	_____	_____	_____	_____	_____	easy
b.	clear	_____	_____	_____	_____	_____	_____	_____	confusing
c.	meaningful	_____	_____	_____	_____	_____	_____	_____	meaningless
d.	uninteresting	_____	_____	_____	_____	_____	_____	_____	interesting
e.	valuable	_____	_____	_____	_____	_____	_____	_____	worthless

7. Instruction that allows me to use movies, tapes, graphs, models are.

		1	2	3	4	5	6	7	
a.	difficult	_____	_____	_____	_____	_____	_____	_____	easy
b.	clear	_____	_____	_____	_____	_____	_____	_____	confusing
c.	meaningful	_____	_____	_____	_____	_____	_____	_____	meaningless
d.	uninteresting	_____	_____	_____	_____	_____	_____	_____	interesting
e.	valuable	_____	_____	_____	_____	_____	_____	_____	worthless

8. I find that classes that require a great deal of computation and formula work are:

		1	2	3	4	5	6	7	
a.	difficult	_____	_____	_____	_____	_____	_____	_____	easy
b.	clear	_____	_____	_____	_____	_____	_____	_____	confusing
c.	meaningful	_____	_____	_____	_____	_____	_____	_____	meaningless
d.	uninteresting	_____	_____	_____	_____	_____	_____	_____	interesting
e.	valuable	_____	_____	_____	_____	_____	_____	_____	worthless

9. I find that instruction that involves a great amount of verbal (talk) exchange is:

		1	2	3	4	5	6	7	
a.	difficult	_____	_____	_____	_____	_____	_____	_____	easy
b.	clear	_____	_____	_____	_____	_____	_____	_____	confusing
c.	meaningful	_____	_____	_____	_____	_____	_____	_____	meaningless
d.	uninteresting	_____	_____	_____	_____	_____	_____	_____	interesting
e.	valuable	_____	_____	_____	_____	_____	_____	_____	worthless

10. I find that learning by lectures is:

		1	2	3	4	5	6	7	
a.	difficult	_____	_____	_____	_____	_____	_____	_____	easy
b.	clear	_____	_____	_____	_____	_____	_____	_____	confusing
c.	meaningful	_____	_____	_____	_____	_____	_____	_____	meaningless
d.	uninteresting	_____	_____	_____	_____	_____	_____	_____	interesting
e.	valuable	_____	_____	_____	_____	_____	_____	_____	worthless

11. A learning situation that is organized in such a way that I don't have to make decisions is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

12. A highly structured class that keeps me continually busy and involved is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

13. I find that complete and detailed direction during a class is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

14. A learning situation that requires me to sit, take notes, recite answers and take tests is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

15. A learning situation that has everything arranged from simple to complex is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

16. I find that learning by myself is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

17. If I am allowed to learn at my own rate of speed I find that learning is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

18. I find a learning situation that has no obvious organization:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

19. Learning without a teacher always nearby is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

20. A learning situation that leaves me to determine my own goals is:

	1	2	3	4	5	6	7	
a. difficult								easy
b. clear								confusing
c. meaningful								meaningless
d. uninteresting								interesting
e. valuable								worthless

21. I find that handling or studying working models of machines and equipment makes learning

	1	2	3	4	5	6	7	
a. difficult	____	____	____	____	____	____	____	easy
b. clear	____	____	____	____	____	____	____	confusing
c. meaningful	____	____	____	____	____	____	____	meaningless
d. uninteresting	____	____	____	____	____	____	____	interesting
e. valuable	____	____	____	____	____	____	____	worthless

22. I find that veiwing, interpreting and constructing graphic representations (drawings, charts, graphs) of materials, processes, machines or data makes learning:

	1	2	3	4	5	6	7	
a. difficult	____	____	____	____	____	____	____	easy
b. clear	____	____	____	____	____	____	____	confusing
c. meaningful	____	____	____	____	____	____	____	meaningless
d. uninteresting	____	____	____	____	____	____	____	interesting
e. valuable	____	____	____	____	____	____	____	worthless

Appendix B

Pilot Learning Activities Attitude Scale

LEARNING ACTIVITIES ATTITUDE SCALE

Directions: The statements below describe a variety of activities used to learn skills and knowledges. Read each statement. Respond to the statement on the basis of its value to you in a learning situation. React according to the following scale:

1-Of No Value, 2-Somewhat Valuable, 3-Of Average Value
4-Very Valuable, 5-Extremely Valuable

Place your answers on the answer sheet provided. Darken the space under the number that represents your response Be sure to go across the answer sheet. There are no right or wrong statements-just the value to you in learning.

		Of No Value	Somewhat Valuable	Of Average Value	Very Valuable	Extremely Valuable
1.	Working with tools, equipment and materials:	1	2	3	4	5
2.	Working with groups of students:	1	2	3	4	5
3.	Laboratory Activities:	1	2	3	4	5
4.	Classes that teach job skills:	1	2	3	4	5
5.	Traditional lecture instruction with support of films, slides, tapes, etc.:	1	2	3	4	5
6.	Discussion Activities:	1	2	3	4	5
7.	Self instruction using media (films, tapes, slides):	1	2	3	4	5
8.	Instruction dealing with formulas, figures and computations:	1	2	3	4	5
9.	Instruction offered only through media (movies, tapes, films, and slides):	1	2	3	4	5
10.	Instruction based on a vast amount of reading:	1	2	3	4	5
11.	Everything set up for me:	1	2	3	4	5
12.	Teacher centered instruction:	1	2	3	4	5
13.	Lecture, note taking instruction:	1	2	3	4	5
14.	Completely organized courses:	1	2	3	4	5
15.	Working alone and setting my own pace:	1	2	3	4	5
16.	Courses that allow me to set my own objectives:	1	2	3	4	5
17.	Courses that allow me to establish my own learning sequence and activities:	1	2	3	4	5
18.	Student centered instruction:	1	2	3	4	5
19.	Classes involving no amount of student/teacher contact:	1	2	3	4	5
20.	Student organized instruction:	1	2	3	4	5

Appendix C

Final Learning Activities Opinionnaire

Learning Activities Opinionnaire

The following survey form describes various activities that you may use in learning skills and knowledges. Some of these activities may be of more value to you than other activities. What we want you to think about is "how" you are best able to learn. What things motivate you to learn and while learning what activities prove valuable to you.

This is not an evaluation of the class you are presently in but an attempt to determine which learning activities are best suited to you as an individual. When you read these statements think about all of the classes you have taken, and the learning activities that proved valuable to you.

Please follow the example below when completing the I.B.M. answer form. Fill in all information clearly and legibly. Leave the identification block blank.

NAME _____ (LAST FIRST MIDDLE) DATE _____ AGE _____ SEX _____ DATE OF BIRTH _____

SCHOOL _____ CITY _____ GRADE OR CLASS _____ Program _____

NAME OF TEST _____ PART 1 2

Please turn to the following page, read the instructions and begin.

Learning Activities Opinionnaire

Directions: The statements below describe a variety of activities used to learn skills and knowledges. Read each statement. Respond to the statement on the basis of its value to you in a learning situation. React according to the following scale:

1 - Of No Value, 2 - Somewhat Valuable, 3 - Of Average Value,
4 - Very Valuable, 5 - Extremely Valuable

Place your answers on the answer sheet provided. Darken the space under the number that represents your response. Be sure to go across the answer sheet. There are no right or wrong statements - just the value to you in learning.

		Of No Value	Somewhat Valuable	Of Average Value	Very Valuable	Extremely Valuable
1.	Working with tools, equipment, apparatus and materials.	1	2	3	4	5
2.	Working and meeting with individuals or groups of people to learn new information and ideas.	1	2	3	4	5
3.	Activities involving the use of scale models, devices, and simulated situations. (Role playing, driver training simulator, games).	1	2	3	4	5
4.	Activities that teach job skills.	1	2	3	4	5
5.	Learning activities in which information and skills are presented by television, teacher or a classmate.	1	2	3	4	5
6.	Activities that allow me to immediately apply what I learn to actual problems I face.	1	2	3	4	5
7.	Learning experiences that only use verbal presentation to teach new information.	1	2	3	4	5
8.	Instruction using media (films, tapes, slides) to pictorially and graphically describe events, skills and procedures.	1	2	3	4	5
9.	Instruction dealing with formulas and symbols which describe the knowledges to be learned.	1	2	3	4	5
10.	Instruction based mainly on reading.	1	2	3	4	5
11.	Verbal instruction (written or oral) presented by a teacher with support of films, slides, and tapes.	1	2	3	4	5
12.	Classes where everything is set up allowing me no choice in determining goals or objectives.	1	2	3	4	5
13.	Teacher organized instruction where I have little influence on the type of instructional material and learning activities used.	1	2	3	4	5

		Of No Value	Somewhat Valuable	Of Average Value	Very Valuable	Extremely Valuable
14.	Class situations that lead me from simple to complex learning activities with pre-determined goals, objectives and sequence.	1	2	3	4	5
15.	Working alone but with const nt teacher supervision and organization.	1	2	3	4	5
16.	Organized situations from simple to complex giving me a choice of where I want to start, stop or branch out to new experiences.	1	2	3	4	5
17.	Learning activities that have no pre-set goals, you just set your own and do what you want.	1	2	3	4	5
18.	Working alone and setting my own pace, determining my own goals and objectives.	1	2	3	4	5
19.	Courses that allow me to establish my own learning sequence and activities.	1	2	3	4	5
20.	Student designed, and directed instructional activities.	1	2	3	4	5
21.	Classes involving a minimum amount of organization.	1	2	3	4	5
22.	Instruction completely organized by me.	1	2	3	4	5

Appendix D

Weighted Scores Analysis Program

BEST COPY AVAILABLE

Table D-1

```
PAGE   1    06/19/73    U W - STOUT     COMPUTER CENTER                01            PRNTZ 1
// JOB
LOG DRIVE   CART SPEC   CART AVAIL  PHY DRIVE
  0000         7001         7001        0000
/2 M11   ACTUAL  8K  CONFIG  8K                                                      PRNTZ 2
*EQUAT(PRNTZ,PRNTY)
// IDD 300    DENNIS BEACH
// FOR
         *ONE WORD INTEGERS
         *IOCS(CARD,1132 PRINTER)
         *EXTENDED PRECISION

C-ERRS...STNO.C.....  F O R T R A N   S O U R C E   S T A T E M E N T S  ........  IDENTFCN    **COMPILER MESSAGES**

         C       *****WEIGHTED ANALYSIS PROGRAM 1-5 RESPONCES*******
         C     CHECK INSTRUCTION SHEET FOR PROGRAM DISCRIPTION AND INPUT CONFIGURATION
         C     *******PROGRAM WRITTEN BY DENNIS BEACH UNIV. WIS-STOUT**********
               DIMENSION IKEY(55),SN(200),PCT(3),CC(5),UL(5),QQ(3)
               DIMENSION IST(25)
               DIMENSION SX(70),SXS(70),SXY(70),TOTSC(200),NT(71),          IANAL(
              *70,6),Q(5),HEAD(10),NR(142),IVAL(70),P(6)
               DATA IST/'  ',24**' '/
               DATA PCT,UL/0.25,0.50,0.75,1.5,2.5,3.5,4.5,5.5/
         C     READ IN KEY FOR DECODING MACHINE SCORED DATA
               READ(2,1)IKEY,Q
             1 FORMAT(55A1,5X,5A1)
         C     READ IN HEADER CARD N1 IS STARTING POINT, N IS END POINT
           101 READ(2,2)HEAD,N1,N,CHECK,ICHK,ISUP
             2 FORMAT(10A4,2I3,F6.0,2I1)
               ICHK=ICHK+1
               NUM=N
         C     READ IN VALENCE CARD
               READ(2,104)IVAL
           104 FORMAT(70I1)
         C     ZERO ARRAYS FOR NEXT SET OF DATA
               SY=0.0
               SYS=0.0
               SXT=0.0
               DO 103 I=1,200
           103 TOTSC(I)=0.0
               DO 3 I=N1,N
               SX(I)=0.0
               SXS(I)=0.0
               SXY(I)=0.0
               DO 3 J=1,6
             3 IANAL(I,J)=0.0
               NN=0
         C     READ IN DATA CODED OR NUMERIC DEPENDING ON VALUE OF ICHK
            20 GO TO(310,311),ICHK
           311 READ(2,312)ANUM,(NR(JF),JF=1,16)
           312 FORMAT(F2.0/19X,8I1,1X,I1,1X,2I1,1X,4I1,2X,I1/)
               IF(ANUM)50,313,313
           310 READ(2,4)ANUM,NT
             4 FORMAT(F9.0,71A1)
               IF(ANUM)50,5,5
         C     CALL DECODE SUBROUTINE TO DECODE DATA
             5 CALL I230(IKEY,NT,NR,NUM,ANUM)
           313 NN=NN+1
               DO 9 I=N1,N
               IF(NR(I)-(5-ISUP))350,350,351
```

Table D-2

```
PAGE   2    06/19/73

C-ERES...STNO.C..... F O R T R A N   S O U R C E   S T A T E M E N T S ........ IDENTFCN    **COMPILER MESSAGES**

          351 NR(I)=0
          350 CONTINUE
              J=NR(I)+1
        C     CHECK VALANCE AND REVERSE VALUES IF CALLED FOR
              IF(IVAL(I))7,7,8
            8 IF(NR(I))7,7,430
          430 NR(I)=3-(NR(I)-3)
              NR(I)=NR(I)-ISUP
        C     COMPUTE VARIOUS SUMS NEEDED FOR CALCULATIONS
            7 TOTSC(NN)=TOTSC(NN)+NR(I)
                (I)=SX(I)+NR(I)
              SXS(I)=SXS(I)+NR(I)**2
              IANAL(I,J)=IANAL(I,J)+1
            9 CONTINUE
              SN(NN)=ANUM
               SY=SY+TOTSC(NN)
              SYS=SYS+TOTSC(NN)**2
              SXT=SXT+TOTSC(NN)
              DO 12 I=N1,N
           12 SXY(I)=SXY(I)+NR(I)*TOTSC(NN)
              GO TO 20
           50 XN=NN
              SDTSC=(1.0/XN)*SQRT(SYS*XN-SY**2)
        C     WRITE HEADING FOR SCORES AND PRINT OUT SCORES FOR EACH INDIVIDUAL
              WRITE(3,951)HEAD,N1,N,NN
          951 FORMAT('1',20X,10A4//21X,'TEST ANALYSIS FROM QUES',I3,' TO QUES',I
             *3,5X,'STUDENTS =',I4//21X,'STUDENT',10X,'SCORE'/)
              DO 952 KK=1,NN
          952 WRITE(3,10)SN(KK),TOTSC(KK)
           10 FORMAT(20X,F11.0,8X,F4.0/)
              WRITE(3,100)
          100 FORMAT('1','ITEM',5X,'OMIT',7X,'1',7X,'2',7X,'3',7X,'4',7X,'5',7X,
             *'MEAN',5X,'STAN DEV',3X,'P-COR',5X,'Q1',6X,'Q2',6X,'Q3',6X,'IQR'/)
        C     CALCULATE PEARSON CORRELATION
              DO 60 I=N1,N
              PCOR=XN*SXY(I)-SX(I)*SY
              R=SQRT((XN*SXS(I)-SX(I)**2)*(XN*SYS-SY**2))
              PCOR=PCOR/R
        C     CALCULATE PERCENT FOR EACH RESPONCE
              DO 22 J=1,6
              PP=IANAL(I,J)
           22 P(J)=PP/XN
              TP=0.0
        C     CALCULATE QUARTILE VALUES
              DO 301 JJ=1,5
              TP=TP+P(JJ+1)
          301 CC(JJ)=TP
              DO 777 JQ=1,5
          777 CC(JQ)=CC(JQ)/TP
              XSAVE=XN
              XN=XN*TP
               XB=SX(I)/XN
              IF(IVAL(I))701,701,702
          702 XSUP=ISUP
```

Table D-3

```
PAGE   3    06/19/73

C-ERRS...STMO.C..... F O R T R A N   S O U R C E   S T A T E M E N T S ........ IDENTFCN    **COMPILER MESSAGES**

               XB=(6.0-XSUP)-XB
           701 CONTINUE
               SD=(1.0/XN)*SQRT((SXS(I)*XN-SX(I)**2))
               XN=XSAVE
               DO 302 KZ=1,3
               DO 303 KX=1,5
               IF(PCT(KZ)-CC(KX))304,304,303
           304 AA=CC(KX)-PCT(KZ)
               AZ=P(KX+1)/TP
               AB=AA/AZ
               QQ(KZ)=UL(KX)-AB
               GO TO 302
           303 CONTINUE
           302 CONTINUE
               QR=QQ(3)-QQ(1)
             C PRINT F-DIST QUARTILES,MEAN,STAN DEV AND P-COR
               WRITE(3,21)I,P,XB,SD,PCOR,QQ,QR
            21 FORMAT(1X,I3,F11.3,F9.3,4F8.3,F10.3,F10.3,F9.3,F10.3,3F8.3/)
               IF((I-N1)-28)880,881,880
           880 IF((I-N1)-56)882,881,882
           881 WRITE(3,100)
           882 CONTINUE
            60 CONTINUE
               XNN=(N-N1)+1
               YSS=0.0
               XSS=0.0
                Z=(SY**2)/(XN*XNN)
               A=(SYS/XNN)-Z
               DO 62 I=N1,N
               XSS=XSS+SX(I)**2
            62 YSS=YSS+SXS(I)
               B=(XSS/XN)-Z
                T=YSS-Z
               C=T-(A+B)
             C CALCULATE DEGREES OF FREEDOM
             C CALCULATE MEAN SQUARES FOR ANALYSIS OF VARIANCE
               DF1=NN-1
                DF2=N-1
               DF3=DF1*DF2
                DF4=(NN*N)-1.0
                AP=A/DF1
               BP=B/DF2
               CP=C/DF3
               TP=T/DF4
             C PRINT ANALYSIS OF VARIANCE TABLE
               WRITE(3,70)DF1,A,AP,DF2,B,BP,DF3,C,CP,DF4,T,TP
            70 FORMAT('1',30X,'TEST RELIABILITY'///10X,'SOURCE',20X,'DF',13X,'&S'
              *,13X,'M.S.'//3X,'AMONG INDIVIDUALS',11X,F5.0,F17.4,F18.5//5X,'AMON
              *G ITEMS',F22.0,F17.4,F18.5//5X,'RESIDUAL',F25.0,F17.4,F18.5//5X,'T
              *OTAL',F28.0,F17.4,F18.5///)
             C CALCULATE AND PRINT RELIABILITY COEFFICIENT, STANDARD ERROR OF
             C MEASUREMENT AND MEAN SCORE
               RTT=(AP-CP)/AP
               SE=SQRT(XNN*CP)
               XB=SXT/XN
```

Table D-4

```
PAGE   4    06/19/73

C-ERRS...STNO.C..... F O R T R A N  S O U R C E  S T A T E M E N T S ..... IDENTFCN    **COMPILER MESSAGES**

            WRITE(3,71)RTT,SE,XB
         71 FORMAT(20X,'RELIABILITY COEFFICIENT =',F10.5//20X,'STANDARD ERROR
           *OF MEASUREMENT =',F10.5//20X,'MEAN SCORE =',F10.3/)
            WRITE(3,703)SDTSC
        703 FORMAT(20X,'STANDARD DEVIATION =',F10.3/)
            WRITE(3,150)
        150 FORMAT('1',30X,'FREQUENCY DISTRIBUTION'//)
      C     PRINT F-DIST FOR TOTAL SCORES
            K=((N-N1)+1)*5
            K=K+1
            IK=0
            DO 151 J=1,K
            L=K-J
            IC=1
            DO 152 I=1,NN
            JJ=10TSC(I)+0.5
            IF(L-JJ)152,153,152
        153 IK=IK+1
            IC=IC+1
        152 CONTINUE
            IF(IK)151,151,158
        158 WRITE(3,170)L,(IST(II),II=1,IC)
        170 FORMAT('0',10X,I4,5X,25A2)
            IF(IK-NN)151,999,999
        151 CONTINUE
        999 IF(CHECK)1000,101,101
       1000 CALL EXIT
            END

FEATURES SUPPORTED
 ONE WORD INTEGERS
 EXTENDED PRECISION
 IOCS-
   1132 PRINTER
   CARD

CORE REQUIREMENTS FOR -
 COMMON-     0,   VARIABLES AND TEMPORARIES-  2870,   CONSTANTS AND PROGRAM-  1696

END OF SUCCESSFUL COMPILATION
// XEQ
```

Appendix E

Concrete/Symbolic Learning Styles Continuum
Item Analysis (Pilot)

Table E-1

CHILD CARE GROUP I PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.047	0.190	0.238	0.523	4.238	0.920	0.632	3.550	4.545	5.022	1.472
2	0.000	0.000	0.142	0.142	0.428	0.285	3.857	0.989	0.495	3.250	4.000	4.625	1.375
3	0.000	0.047	0.095	0.380	0.285	0.190	3.476	1.051	0.458	2.781	3.437	4.291	1.510
4	0.000	0.047	0.000	0.142	0.285	0.523	4.238	1.019	0.693	3.708	4.545	5.022	1.314
5	0.000	0.047	0.047	0.238	0.428	0.238	3.761	1.019	0.149	3.150	3.888	4.472	1.322
6	0.000	0.000	0.095	0.238	0.238	0.428	4.000	1.023	0.404	3.150	4.200	4.916	1.766
7	0.047	0.142	0.380	0.190	0.190	0.047	2.599	1.113	0.604	1.781	2.437	3.687	1.906
8	0.000	0.428	0.285	0.142	0.142	0.000	2.000	1.069	0.183	1.083	1.750	2.750	1.666
9	0.000	0.285	0.333	0.142	0.142	0.095	2.428	1.293	0.586	1.375	2.142	3.416	2.041
10	0.000	0.190	0.380	0.428	0.000	0.000	2.238	0.749	0.037	1.656	2.312	2.916	1.260

Table E-2

CHILD CARE GROUP II PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.333	0.583	0.083	3.750	0.595	0.603	3.250	3.785	4.214	0.964
2	0.000	0.000	0.000	0.166	0.416	0.416	4.250	0.721	0.338	3.700	4.300	4.900	1.200
3	0.000	0.000	0.083	0.416	0.250	0.250	3.666	0.942	0.243	2.900	3.500	4.500	1.600
4	0.000	0.000	0.000	0.166	0.416	0.416	4.250	0.721	0.417	3.700	4.300	4.900	1.200
5	0.000	0.000	0.166	0.416	0.083	0.333	3.583	1.114	0.347	2.700	3.300	4.750	2.050
6	0.000	0.000	0.000	0.166	0.500	0.333	4.166	0.687	-0.041	3.666	4.166	4.750	1.083
7	0.000	0.166	0.416	0.250	0.166	0.000	2.416	0.953	0.406	1.700	2.300	3.166	1.466
8	0.000	0.333	0.250	0.416	0.000	0.000	2.083	0.862	0.283	1.250	2.166	2.900	1.650
9	0.000	0.333	0.333	0.166	0.166	0.000	2.166	1.067	0.538	1.250	2.000	3.000	1.750
10	0.000	0.166	0.500	0.333	0.000	0.000	2.166	0.687	0.292	1.666	2.166	2.750	1.083

Table E-3

CHILD CARE GROUP III PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.062	0.250	0.250	0.437	4.062	0.966	0.471	3.250	4.250	4.928	1.678
2	0.000	0.062	0.000	0.062	0.687	0.187	3.937	0.899	0.550	3.681	4.045	4.409	0.727
3	0.000	0.062	0.062	0.500	0.187	0.187	3.375	1.053	0.577	2.750	3.250	4.166	1.416
4	0.000	0.000	0.000	0.187	0.312	0.500	4.312	0.768	0.004	3.700	4.500	5.000	1.299
5	0.000	0.062	0.125	0.312	0.187	0.312	3.562	1.223	-0.046	2.700	3.500	4.700	2.000
6	0.000	0.000	0.125	0.250	0.437	0.187	3.687	0.916	0.105	3.000	3.785	4.357	1.357
7	0.000	0.187	0.500	0.125	0.187	0.000	2.312	0.982	0.698	1.625	2.125	3.000	1.375
8	0.000	0.437	0.437	0.125	0.000	0.000	1,687	0.681	0.032	1.071	1.642	2.214	1.142
9	0.000	0.312	0.437	0.187	0.062	0.000	2.000	0.866	0.710	1.300	1.928	2.500	1.200
10	0.000	0.312	0.437	0.187	0.062	0.000	2.000	0.866	0.494	1.300	1.928	2.500	1.200

Table E-4

AUDIO-VISUAL TUTORIAL TYPING PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.333	0.666	4.666	0.471	-0.090	4.250	4.750	5.125	0.875
2	0.000	0.200	0.133	0.466	0.200	0.000	2.666	1.011	0.147	1.875	2.857	3.392	1.517
3	0.000	0.000	0.133	0.133	0.333	0.400	4.000	1.032	0.227	3.375	4.200	4.875	1.500
4	0.000	0.000	0.000	0.133	0.333	0.533	4.400	0.711	0.275	3.850	4.562	5.031	1.181
5	0.000	0.066	0.200	0.266	0.266	0.200	3.333	1.192	-0.035	2.416	3.375	4.312	1.895
6	0.000	0.133	0.066	0.333	0.266	0.200	3.333	1.247	0.000	2.650	3.400	4.312	1.662
7	0.000	0.000	0.200	0.066	0.466	0.266	3.800	1.045	0.644	3.250	4.000	4.562	1.312
8	0.000	0.200	0.200	0.333	0.066	0.200	2.866	1.359	0.445	1.750	2.800	3.750	2.000
9	0.000	0.066	0.333	0.266	0.133	0.200	3.066	1.236	0.652	2.050	2.875	4.125	2.075
10	0.000	0.200	0.466	0.266	0.066	0.000	2.200	0.832	0.650	1.607	2.142	2.812	1.205

Table E-5

ACCOUNTING II PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.090	0.181	0.409	0.318	3.954	0.928	0.152	3.375	4.055	4.714	1.339
2	0.000	0.000	0.080	0.363	0.409	0.136	3.590	0.834	0.084	2.937	3.611	4.222	1.284
3	0.000	0.000	0.136	0.363	0.454	0.045	3.409	0.778	0.090	2.812	3.500	4.050	1.237
4	0.000	0.000	0.045	0.181	0.227	0.545	4.272	0.913	0.463	3.600	4.583	5.041	1.441
5	0.000	0.000	0.181	0.545	0.227	0.045	3.136	0.756	-0.233	2.625	3.083	3.600	0.975
6	0.000	0.000	0.227	0.318	0.409	0.045	3.272	0.862	0.572	2.571	3.357	4.000	1.428
7	0.000	0.000	0.136	0.363	0.363	0.136	3.500	0.891	0.276	2.812	3.500	4.187	1.375
8	0.000	0.000	0.318	0.409	0.272	0.000	2.954	0.767	0.137	2.285	2.944	3.583	1.297
9	0.000	0.090	0.545	0.181	0.136	0.045	2.500	0.988	0.464	1.791	2.250	3.125	1.333
10	0.000	0.318	0.363	0.227	0.045	0.045	2.136	1.057	0.700	1.285	2.000	2.800	1.514

Table E-6

AUTOMORILE TECHNOLOGY PILOT ADMINISTRATION ITEM ANALYSIS
CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.083	0.916	4.916	0.276	-0.279	4.681	4.954	5.227	0.545
2	0.000	0.166	0.333	0.166	0.250	0.083	2.750	1.233	0.258	1.750	2.500	3.833	2.083
3	0.000	0.000	0.000	0.083	0.166	0.750	4.666	0.623	0.588	4.500	4.833	5.166	0.666
4	0.000	0.000	0.000	0.000	0.166	0.833	4.833	0.372	0.459	4.600	4.900	5.200	0.600
5	0.000	0.000	0.083	0.250	0.416	0.250	3.833	0.897	0.664	3.166	3.900	4.500	1.333
6	0.000	0.000	0.083	0.000	0.583	0.333	4.166	0.799	0.214	3.785	4.214	4.750	0.964
7	0.000	0.083	0.333	0.333	0.166	0.083	2.833	1.067	0.707	2.000	2.750	3.500	1.500
8	0.000	0.083	0.583	0.250	0.083	0.000	2.333	0.745	0.559	1.785	2.214	2.833	1.047
9	0.000	0.416	0.416	0.166	0.000	0.000	1.750	0.721	0.633	1.100	1.700	2.300	1.200
10	0.000	0.166	0.666	0.166	0.000	0.000	2.000	0.577	0.260	1.625	2.000	2.375	0.750

Appendix F

Structured/Unstructured Learning Styles Continuum
Item Analysis (Pilot)

Table F-1

CHILD CARE GROUP I PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.142	0.142	0.523	0.142	0.047	2.809	1.005	0.340	2.250	2.909	3.386	1.136
12	0.000	0.047	0.238	0.333	0.238	0.142	3.190	1.096	0.539	2.350	3.142	4.050	1.700
13	0.000	0.095	0.190	0.380	0.142	0.190	3.142	1.206	0.081	2.312	3.062	4.083	1.770
14	0.000	0.095	0.190	0.238	0.238	0.238	.333	1.284	0.361	2.312	3.400	4.450	2.137
15	0.000	0.000	0.285	0.285	0.238	0.190	3.333	1.083	0.294	2.375	3.250	4.250	1.875
16	0.000	0.000	0.142	0.190	0.333	0.333	3.857	1.036	0.334	3.062	4.000	4.750	1.687
17	0.000	0.047	0.047	0.190	0.428	0.285	3.857	1.036	0.538	3.312	4.000	4.625	1.312
18	0.000	0.142	0.095	0.523	0.142	0.095	2.952	1.090	0.601	2.522	3.000	3.477	0.954
19	0.000	0.619	0.333	0.047	0.000	0.000	1.428	0.583	0.073	0.903	1.307	1.892	0.989
20	0.000	0.142	0.333	0.333	0.095	0.095	2.666	1.126	0.357	1.821	2.571	3.321	1.500

Table F-2

CHILD CARE GROUP II PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.000	0.250	0.333	0.416	0.000	3.166	0.799	0.131	2.500	3.250	3.900	1.400
12	0.000	0.000	0.083	0.416	0.333	0.166	3.583	0.862	0.609	2.900	3.500	4.250	1.350
13	0.000	0.000	0.250	0.250	0.250	0.250	3.500	1.118	0.735	2.500	3.500	4.500	2.000
14	0.000	0.083	0.083	0.333	0.166	0.333	3.583	1.255	0.710	2.750	3.500	4.750	2.000
15	0.000	0.166	0.250	0.166	0.333	0.083	2.916	1.255	0.362	1.833	3.000	4.000	2.166
16	0.000	0.000	0.083	0.583	0.250	0.083	3.333	0.745	0.446	2.785	3.214	3.833	1.047
17	0.000	0.000	0.166	0.416	0.333	0.083	3.333	0.849	0.535	2.700	3.300	4.000	1.300
18	0.000	0.083	0.416	0.416	0.083	0.000	2.499	0.763	0.687	1.900	2.500	3.100	1.200
19	0.000	0.833	0.166	0.000	0.000	0.000	1.166	0.372	0.187	0.800	1.100	1.400	0.600
20	0.000	0.083	0.333	0.500	0.083	0.000	2.583	0.759	0.760	2.000	2.666	3.166	1.166

Table F-3

CHILD CARE GROUP III PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.437	0.187	0.250	0.062	0.062	2.125	1.218	0.454	1.071	1.833	3.000	1.928
12	0.000	0.000	0.375	0.437	0.062	0.125	2.937	0.966	0.548	2.166	2.785	3.357	1.190
13	0.000	0.062	0.375	0.375	0.125	0.062	2.750	0.968	0.546	2.000	2.666	3.333	1.333
14	0.000	0.062	0.250	0.187	0.312	0.187	3.312	1.210	0.439	2.250	3.500	4.300	2.050
15	0.000	0.062	0.375	0.250	0.125	0.187	3.000	1.224	0.411	2.000	2.750	4.000	2.000
16	0.000	0.000	0.312	0.125	0.312	0.250	3.500	1.172	0.693	2.300	3.700	4.500	2.200
17	0.000	0.000	0.312	0.187	0.375	0.125	3.312	1.043	0.682	2.300	3.500	4.166	1.866
18	0.000	0.000	0.250	0.437	0.187	0.125	3.187	0.949	0.612	2.500	3.071	3.833	1.333
19	0.000	0.875	0.000	0.125	0.000	0.000	1.250	0.661	0.665	0.785	1 071	1.357	0.571
20	0.000	0.000	0.562	0.312	0.125	0.000	2.562	0.704	0.538	1.944	2.388	3.100	1.155

Table F-4

AUDIO-VISUAL TUTORIAL TYPING PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.266	0.200	0.266	0.133	0.133	2.666	1.349	0.150	1.437	2.625	3.625	2.187
12	0.000	0.000	0.066	0.466	0.266	0.200	3.600	0.879	0.731	2.892	3.428	4.312	1.419
13	0.000	0.066	0.333	0.266	0.200	0.133	3.000	1.154	0.591	2.050	2.875	3.916	1.866
14	0.000	0.000	0.133	0.266	0.466	0.133	3.600	0.879	0.661	2.937	3.714	4.250	1.312
15	0.000	0.000	0.066	0.266	0.200	0.466	4.066	0.997	0.753	3.187	4.333	4.964	1.776
16	0.000	0.000	0.066	0.133	0.400	0.400	4.133	0.884	0.687	3.625	4.250	4.875	1.250
17	0.000	0.000	0.200	0.333	0.400	0.066	3.333	0.869	0.690	2.650	3.400	4.041	1.391
18	0.000	0.200	0.200	0.466	0.133	0.000	2.533	0.956	0.386	1.750	2.714	3.250	1.500
19	0.000	0.533	0.133	0.200	0.066	0.066	2.000	1.264	0.628	0.968	1.437	2.916	1.947
20	0.000	0.200	0.400	0.333	0.000	0.066	2.333	1.011	0.127	1.625	2.250	2.950	1.325

Table F-5

ACCOUNTING II PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.272	0.272	0.409	0.045	0.000	2.227	0.901	0.297	1.416	2.333	3.000	1.583
12	0.000	0.045	0.181	0.590	0.136	0.045	2.954	0.824	0.777	2.538	2.961	3.384	0.846
13	0.000	0.181	0.318	0.363	0.136	0.000	2.454	0.940	0.018	1.714	2.500	3.187	1.473
14	0.000	0.000	0.090	0.363	0.409	0.136	3.590	0.834	0.289	2.937	3.611	4.222	1.284
15	0.000	0.000	0.090	0.318	0.454	0.136	3.636	0.828	0.454	3.000	3.700	4.250	1.250
16	0.000	0.000	0.181	0.181	0.545	0.090	3.545	0.890	0.771	2.875	3.750	4.208	1.333
17	0.000	0.045	0.090	0.272	0.454	0.136	3.545	0.987	0.403	2.916	3.700	4.250	1.333
18	0.000	0.000	0.318	0.409	0.272	0.000	2.954	0.767	0.563	2.285	2.944	3.583	1.297
19	0.000	0.636	0.227	0.090	0.045	0.000	1.545	0.838	0.558	0.892	1.285	2.060	1.107
20	0.000	0.045	0.500	0.409	0.045	0.000	2.454	0.655	0.624	1.909	2.409	3.000	1.090

Table F-6

AUTOMOBILE TECHNOLOGY PILOT ADMINISTRATION ITEM ANALYSIS
STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
11	0.000	0.000	0.416	0.416	0.083	0.083	2.833	0.897	-0.564	2.100	2.700	3.300	1.200
12	0.000	0.000	0.333	0.333	0.166	0.166	3.166	1.067	0.404	2.250	3.000	4.000	1.750
13	0.000	0.333	0.250	0.250	0.166	0.000	2.250	1.089	0.232	1.250	2.166	3.166	1.916
14	0.000	0.000	0.000	0.250	0.166	0.583	4.333	0.849	0.485	3.500	4.642	5.071	1.571
15	0.000	0.083	0.166	0.500	0.166	0.083	2.999	0.999	0.581	2.500	3.000	3.500	1.000
16	0.000	0.000	0.166	0.416	0.250	0.166	3.416	0.953	0.579	2.700	3.300	4.166	1.466
17	0.000	0.083	0.083	0.333	0.416	0.083	3.333	1.027	0.602	2.750	3.500	4.100	1.350
18	0.000	0.083	0.250	0.166	0.333	0.166	3.250	1.233	0.631	2.166	3.500	4.250	2.083
19	0.000	0.833	0.166	0.000	0.000	0.000	1.166	0.372	0.251	0.800	1.100	1.400	0.600
20	0.083	0.250	0.166	0.250	0.166	0.083	2.636	1.298	0.791	1.500	2.833	4.000	2.500

Appendix G

Final Concrete/Symbolic Learning Styles
Continuum Item Analysis

Table G-1

DRAWING 500 GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.071	0.214	0.714	4.642	0.610	0.456	4.333	4.800	5.150	0.816
2	0.000	0.000	0.000	0.285	0.214	0.500	4.214	0.860	0.576	3.375	4.500	5.000	1.625
3	0.000	0.142	0.214	0.500	0.000	0.142	2.785	1.145	0.471	2.000	2.785	3.285	1.285
4	0.000	0.000	0.214	0.285	0.214	0.285	3.571	1.115	0.101	2.625	3.500	4.625	2.000
5	0.000	0.071	0.071	0.500	0.285	0.071	3.214	0.939	0.362	2.714	3.214	3.875	1.160
6	0.000	0.071	0.071	0.071	0.214	0.571	4.142	1.245	0.750	3.666	4.625	5.062	1.395
7	0.000	0.500	0.285	0.142	0.000	0.071	1.857	1.124	0.524	1.000	1.500	2.375	1.375
8	0.000	0.071	0.000	0.285	0.500	0.142	3.642	0.971	-0.375	3.125	3.785	4.285	1.160
9	0.000	0.285	0.357	0.142	0.214	0.000	2.285	1.097	0.389	1.375	2.100	3.250	1.875
10	0.000	0.357	0.357	0.214	0.000	0.071	2.071	1.099	0.635	1.200	1.900	2.666	1.466
11	0.000	0.071	0.071	0.428	0.357	0.071	3.285	0.958	0.084	2.750	3.333	4.000	1.250

Table G-2

LIFE DRAWING GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.083	0.166	0.750	4.666	0.623	-0.311	4.500	4.833	5.166	0.666
2	0.000	0.000	0.000	0.166	0.333	0.500	4.333	0.745	-0.179	3.750	4.500	5.000	1.250
3	0.083	0.000	0.166	0.333	0.083	0.333	3.636	1.149	0.154	2.687	3.375	4.812	2.125
4	0.000	0.166	0.166	0.333	0.250	0.083	2.916	1.187	0.266	2.000	3.000	3.833	1.833
5	0.000	0.000	0.250	0.250	0.250	0.250	3.500	1.118	0.097	2.500	3.500	4.500	2.000
6	0.000	0.000	0.000	0.000	0.166	0.833	4.833	0.372	0.130	4.600	5.900	5.200	0.600
7	0.000	0.166	0.250	0.416	0.083	0.083	2.666	1.105	0.373	1.833	2.700	3.300	1.466
8	0.000	0.000	0.000	0.166	0.416	0.416	4.250	0.721	0.252	3.700	4.300	4.900	1.200
9	0.000	0.166	0.500	0.083	0.083	0.166	2.583	1.320	0.653	1.666	2.166	3.500	1.833
10	0.000	0.000	0.583	0.333	0.083	0.000	2.499	0.645	0.395	1.928	2.357	3.000	1.071
11	0.000	0.000	0.000	0.333	0.416	0.250	3.916	0.759	0.256	3.250	3.900	4.500	1.250

Table G-3

PSYCHOLOGY GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.032	0.161	0.225	0.419	0.161	3.516	1.043	0.478	2.750	3.692	4.288	1.538
2	0.000	0.000	0.064	0.258	0.258	0.419	4.032	0.966	-0.184	3.218	4.187	4.903	1.685
3	0.000	0.032	0.129	0.290	0.387	0.161	3.516	1.011	0.364	2.805	3.625	4.270	1.465
4	0.000	0.032	0.258	0.354	0.258	0.096	3.129	1.007	0.524	2.343	3.090	3.906	1.562
5	0.000	0.032	0.096	0.612	0.129	0.129	3.225	0.905	-0.020	2.697	3.105	3.562	0.865
6	0.000	0.000	0.064	0.161	0.290	0.483	4.193	0.930	0.019	3.583	4.444	4.983	1.399
7	0.000	0.000	0.290	0.419	0.225	0.064	3.064	0.877	0.593	2.361	3.000	3.678	1.317
8	0.000	0.032	0.064	0.387	0.258	0.258	3.645	1.033	0.229	2.895	3.562	4.531	1.635
9	0.000	0.064	0.387	0.322	0.161	0.064	2.774	1.006	0.425	1.979	2.650	3.425	1.445
10	0.000	0.096	0.225	0.483	0.161	0.032	2.806	0.930	0.207	2.178	2.866	3.383	1.204
11	0.000	0.000	0.096	0.129	0.516	0.258	3.935	0.877	0.412	3.546	4.031	4.531	0.984

Table G-4

MACHINE TOOL IV GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.083	0.416	0.500	4.416	0.640	0.532	3.900	4.500	5.000	1.099
2	0.000	0.000	0.000	0.166	0.500	0.333	4.166	0.687	0.517	3.666	4.166	4.750	1.083
3	0.000	0.000	0.166	0.416	0.416	0.000	3.250	0.721	0.266	2.700	3.300	3.900	1.200
4	0.000	0.000	0.000	0.500	0.166	0.333	3.833	0.897	0.065	3.000	3.500	4.750	1.750
5	0.000	0.000	0.166	0.333	0.416	0.083	3.416	0.862	-0.017	2.750	3.500	4.100	1.350
6	0.000	0.000	0.083	0.166	0.500	0.250	3.916	0.862	0.532	3.500	4.000	4.500	1.000
7	0.000	0.166	0.333	0.416	0.083	0.000	2.416	0.862	-0.051	1.750	2.500	3.100	1.349
8	0.000	0.000	0.083	0.166	0.583	0.166	3.833	0.799	0.370	3.500	3.928	4.357	0.857
9	0.000	0.083	0.083	0.250	0.500	0.083	3.416	1.037	0.185	2.833	3.666	4.166	1.333
10	0.000	0.333	0.333	0.333	0.000	0.000	2.000	0.816	0.616	1.250	2.000	2.750	1.500
11	0.000	0.000	0.083	0.250	0.416	0.250	3.833	0.897	0.527	3.166	3.900	4.500	1.333

Table G-5

MACHINE SHOP II GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.090	0.909	4.909	0.287	0.481	4.675	4.950	5.225	0.550
2	0.000	0.000	0.090	0.363	0.363	0.181	3.636	0.881	0.162	2.937	3.625	4.312	1.375
3	0.000	0.090	0.000	0.363	0.272	0.272	3.636	1.149	0.684	2.937	3.666	4.583	1.645
4	0.000	0.000	0.000	0.272	0.545	0.181	3.909	0.669	0.820	3.416	3.916	4.375	0.958
5	0.000	0.000	0.000	0.818	0.181	0.000	3.181	0.385	0.648	2.805	3.111	3.416	0.611
6	0.000	0.000	0.000	0.090	0.636	0.272	4.181	0.574	0.434	3.750	4.142	4.583	0.833
7	0.000	0.090	0.454	0.454	0.000	0.000	2.363	0.642	-0.504	1.850	2.400	2.950	1.100
8	0.000	0.000	0.000	0.545	0.272	0.181	3.636	0.771	0.117	2.958	3.416	4.250	1.291
9	0.000	0.000	0.363	0.454	0.181	0.000	2.818	0.715	0.185	2.187	2.800	3.350	1.162
10	0.000	0.090	0.636	0.272	0.000	0.000	2,181	0.574	-0.231	1.750	2.142	2.583	0.833
11	0.000	0.000	0.363	0.272	0.272	0.090	3.090	0.995	-0.331	2.187	3.000	3.916	1.729

Table G-6

MECHANICAL DESIGN IV GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.090	0.272	0.636	4.545	0.655	0.553	4.083	4.714	5.107	1.023
2	0.000	0.000	0.272	0.454	0.090	0.181	3.181	1.028	0.819	2.416	3.000	3.750	1.333
3	0.000	0.000	0.090	0.363	0.454	0.090	3.545	0.782	0.774	2.937	3.600	4.150	1.212
4	0.000	0.000	0.000	0.454	0.272	0.272	3.818	0.833	0.419	3.050	3.666	4.583	1.533
5	0.000	0.000	0.272	0.545	0.000	0.181	3.090	0.995	0.190	2.416	2.916	3.375	0.958
6	0.000	0.000	0.000	0.272	0.454	0.272	4.000	0.738	0.428	3.416	4.000	4.583	1.166
7	0.000	0.181	0.636	0.181	0.000	0.000	2.000	0.603	0.161	1.607	2.000	2.392	0.785
8	0.000	0.000	0.090	0.454	0.363	0.090	3.454	0.782	0.432	2.850	3.400	4.062	1.212
9	0.000	0.000	0.181	0.545	0.272	0.000	3.090	0.668	0.152	2.625	3.083	3.583	0.958
10	0.000	0.090	0.636	0.272	0.000	0.000	2.181	0.574	0.565	1.750	2.142	2.583	0.833
11	0.000	0.000	0.090	0.545	0.363	0.000	3.272	0.616	0.337	2.791	3.250	3.812	1.020

Table G-7

MECHANICAL DESIGN II GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.555	0.444	4.444	0.496	0.194	3.950	4.400	4.937	0.987
2	0.000	0.000	0.111	0.222	0.666	0.000	3.555	0.684	0.324	3.125	3.750	4.125	1.000
3	0.000	0.111	0.111	0.333	0.444	0.000	3.111	0.993	-0.077	2.583	3.333	3.937	1.354
4	0.000	0.111	0.000	0.111	0.555	0.222	3.777	1.133	0.366	3.550	4.000	4.450	0.900
5	0.000	0.000	0.111	0.444	0.333	0.111	3.444	0.831	-0.441	2.812	3.375	4.083	1.270
6	0.000	0.000	0.000	0.222	0.444	0.333	4.111	0.737	0.761	3.562	4.125	4.750	1.187
7	0.000	0.222	0.333	0.222	0.222	0.000	2.444	1.065	0.916	1.583	2.333	3.375	1.791
8	0.000	0.222	0.000	0.111	0.444	0.222	3.444	1.422	0.523	2.750	3.875	4.437	1.687
9	0.000	0.111	0.111	0.333	0.333	0.111	3.222	1.133	-0.221	2.583	3.333	4.083	1.500
10	0.000	0.333	0.333	0.222	0.111	0.000	2.111	0.993	0.895	1.250	2.000	2.875	1.625
11	0.000	0.000	0.222	0.222	0.333	0.222	3.555	1.065	0.580	2.625	3.666	4.416	1.791

Table G-8

INDUSTRIAL DRAFTING II GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.125	0.125	0.375	0.375	4.000	1.000	-0.083	3.500	4.166	4.833	1.333
2	0.000	0.000	0.000	0.375	0.500	0.125	3.750	0.661	-0.158	3.166	3.750	4.250	1.083
3	0.000	0.000	0.000	0.625	0.250	0.125	3.500	0.707	0.177	2.900	3.300	4.000	1.100
4	0.000	0.000	0.125	0.000	0.500	0.375	4.125	0.927	-0.394	3.750	4.250	4.833	1.083
5	0.000	0.000	0.375	0.250	0.250	0.125	3.125	1.053	-0.029	2.166	3.000	4.000	1.833
6	0.000	0.000	0.125	0.125	0.250	0.500	4.125	1.053	0.287	3.500	4.500	5.000	1.500
7	0.000	0.000	0.500	0.375	0.000	0.125	2.750	0.968	0.539	2.000	2.500	3.166	1.166
8	0.000	0.000	0.250	0.125	0.375	0.250	3.625	1.111	0.216	2.500	3.833	4.500	2.000
9	0.000	0.000	0.250	0.125	0.375	0.250	3.625	1.111	0.065	2.500	3.833	4.500	2.000
10	0.000	0.000	0.375	0.375	0.125	0.125	3.000	1.000	0.418	2.166	2.833	3.500	1.333
11	0.000	0.000	0.125	0.625	0.125	0.125	3.250	0.829	0.479	2.700	3.100	3.500	0.799

Table G-9

AUTO BODY IV GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.000	1.000	5.000	[illegible].000	0.000	4.750	5.000	5.250	0.500
2	0.000	0.000	0.083	0.250	0.250	0.416	4.000	0.999	0.135	3.166	4.166	4.900	1.733
3	0.000	0.000	0.250	0.500	0.083	0.166	3.166	0.986	0.298	2.500	3.000	3.500	1.000
4	0.000	0.000	0.000	0.166	0.416	0.416	4.250	0.721	0.009	3.700	4.300	4.900	1.200
5	0.000	0.083	0.000	0.416	0.333	0.166	3.500	1.040	0.274	2.900	3.500	4.250	1.350
6	0.000	0.000	0.000	0.083	0.333	0.583	4.500	0.645	-0.021	4.000	4.642	5.071	1.071
7	0.083	0.166	0.500	0.166	0.083	0.000	2.181	0.833	0.523	1.625	2.083	2.625	0.999
8	0.000	0.000	0.000	0.666	0.166	0.166	3.500	0.763	0.515	2.875	3.250	4.000	1.125
9	0.000	0.166	0.416	0.250	0.083	0.083	2.499	1.188	0.255	1.700	2.300	3.166	1.466
10	0.000	0.250	0.583	0.000	0.166	0.000	2.083	0.953	0.301	1.500	1.928	2.357	0.857
11	0.000	0.000	0.250	0.333	0.333	0.083	3.250	0.924	0.756	2.500	3.250	4.000	1.500

Table G-10

ELECTRONICS TECHNOLOGY IV GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.000	0.000	0.000	0.250	0.750	4.750	0.433	0.404	4.500	4.833	5.166	0.666
2	0.000	0.000	0.083	0.333	0.500	0.083	3.583	0.759	0.165	3.000	3.666	4.166	1.166
3	0.000	0.000	0.041	0.416	0.375	0.166	3.666	0.799	0.246	3.000	3.611	4.277	1.277
4	0.000	0.000	0.000	0.208	0.416	0.375	4.166	0.745	0.295	3.600	4.200	4.833	1.233
5	0.000	0.000	0.041	0.500	0.333	0.125	3.541	0.762	0.352	2.916	3.416	4.125	1.208
6	0.000	0.000	0.000	0.166	0.291	0.541	4.375	0.753	0.105	3.785	4.576	5.038	1.252
7	0.000	0.083	0.583	0.208	0.041	0.083	2.458	0.999	0.207	1.785	2.214	2.900	1.114
8	0.000	0.000	0.166	0.416	0.375	0.041	3.291	0.789	0.225	2.700	3.300	3.944	1.244
9	0.000	0.041	0.041	0.375	0.416	0.125	3.541	0.911	0.387	2.944	3.600	4.200	1.255
10	0.000	0.291	0.375	0.291	0.041	0.000	2.083	0.862	0.404	1.357	2.055	2.785	1.428
11	0.000	0.000	0.166	0.291	0.416	0.125	3.500	0.912	0.571	2.785	3.600	4.200	1.414

Table G-11

CONSERVATION IV GROUP ITEM ANALYSIS CONCRETE/SYMBOLIC
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
1	0.000	0.018	0.018	0.018	0.452	0.490	4.377	0.782	0.318	3.927	4.479	4.990	1.063
2	0.000	0.000	0.056	0.339	0.490	0.113	3.660	0.750	0.479	3.069	3.711	4.221	1.151
3	0.000	0.037	0.245	0.320	0.283	0.113	3.188	1.047	0.520	2.365	3.176	4.016	1.651
4	0.000	0.000	0.037	0.132	0.471	0.358	4.150	0.786	0.329	3.670	4.200	4.802	1.132
5	0.000	0.018	0.207	0.471	0.245	0.056	3.113	0.861	0.094	2.550	3.080	3.711	1.161
6	0.000	0.000	0.056	0.188	0.433	0.320	4.018	0.857	0.455	3.510	4.086	4.720	1.209
7	0.000	0.245	0.396	0.283	0.056	0.018	2.207	0.938	0.323	1.511	2.142	2.883	1.371
8	0.000	0.113	0.132	0.358	0.283	0.113	3.150	1.139	0.326	2.513	3.210	4.016	1.503
9	0.000	0.113	0.358	0.358	0.169	0.000	2.584	0.899	0.163	1.881	2.578	3.276	1.394
10	0.000	0.471	0.301	0.188	0.018	0.018	1.811	0.932	0.324	1.030	1.593	2.421	1.391
11	0.018	0.037	0.188	0.301	0.433	0.018	3.211	0.905	0.502	2.562	3.375	3.978	1.415

Appendix H

Final Structured/Unstructured Learning Style
Continuum Item Analysis

Table H-1

DRAWING 500 GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.785	0.071	0.000	0.071	0.071	1.571	1.237	0.578	0.818	1.136	1.454	0.636
13	0.000	0.714	0.142	0.142	0.000	0.000	1.428	0.728	0.610	0.850	1.200	1.750	0.899
14	0.000	0.142	0.285	0.500	0.071	0.000	2.500	0.823	0.464	1.875	2.642	3.142	1.267
15	0.000	0.071	0.000	0.285	0.500	0.142	3.642	0.971	0.034	3.125	3.785	4.285	1.160
16	0.000	0.071	0.000	0.000	0.571	0.357	4.142	0.989	-0.032	3.812	4.250	4.800	0.987
17	0.000	0.000	0.071	0.357	0.142	0.428	3.928	1.032	0.769	3.000	4.000	4.916	1.916
18	0.000	0.000	0.000	0.214	0.357	0.428	4.214	0.772	0.770	3.600	4.300	4.916	1.316
19	0.000	0.000	0.000	0.428	0.142	0.428	4.000	0.925	0.797	3.083	4.000	4.916	1.833
20	0.000	0.000	0.071	0.285	0.428	0.214	3.785	0.860	0.779	3.125	3.833	4.416	1.291
21	0.000	0.000	0.357	0.357	0.214	0.071	3.000	0.925	0.655	2.200	2.900	3.666	1.466
22	0.071	0.071	0.071	0.428	0.071	0.285	3.461	1.216	0.348	2.708	3.250	4.687	1.979

Table H-2

LIFE DRAWING GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.666	0.166	0.000	0.000	0.166	1.833	1.462	0.254	0.875	1.250	2.000	1.125
13	0.000	0.583	0.250	0.000	0.083	0.083	1.833	1.280	0.511	0.928	1.357	2.166	1.238
14	0.000	0.083	0.083	0.416	0.333	0.083	3.250	1.010	0.492	2.700	3.300	4.000	1.300
15	0.000	0.000	0.083	0.250	0.416	0.250	3.833	0.897	0.356	3.166	3.900	4.500	1.333
16	0.000	0.000	0.166	0.000	0.250	0.583	4.250	0.089	0.149	3.833	4.642	5.071	1.238
17	0.000	0.166	0.250	0.166	0.333	0.083	2.916	1.255	0.762	1.833	3.000	4.000	2.166
18	0.000	0.000	0.083	0.333	0.333	0.250	3.750	0.924	0.404	3.000	3.750	4.500	1.500
19	0.000	0.000	0.000	0.333	0.416	0.250	3.916	0.759	0.171	3.250	3.900	4.500	1.250
20	0.000	0.000	0.000	0.500	0.333	0.166	3.666	0.745	0.181	3.000	3.500	4.250	1.250
21	0.000	0.250	0.166	0.333	0.166	0.083	2.666	1.247	0.475	1.500	2.750	3.500	2.000
22	0.000	0.083	0.250	0.083	0.250	0.333	3.500	1.384	0.387	2.166	3.833	4.750	2.583

Table H-3

PSYCHOLOGY GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.290	0.354	0.225	0.096	0.032	2.225	1.068	0.344	1.361	2.090	2.964	1.603
13	0.000	0.258	0.354	0.322	0.064	0.000	2.193	0.895	0.330	1.468	2.181	2.925	1.456
14	0.000	0.032	0.096	0.387	0.322	0.161	3.483	0.979	0.537	2.812	3.458	4.225	1.412
15	0.000	0.096	0.129	0.419	0.290	0.064	3.096	1.027	0.302	2.557	3.153	3.861	1.303
16	0.000	0.000	0.096	0.193	0.290	0.419	4.032	0.999	-0.038	3.291	4.222	4.903	1.612
17	0.000	0.032	0.354	0.161	0.354	0.096	3.129	1.099	0.730	2.113	3.200	4.068	1.954
18	0.000	0.032	0.193	0.354	0.354	0.064	3.225	0.940	0.700	2.568	3.272	3.977	1.409
19	0.000	0.000	0.225	0.354	0.354	0.064	3.258	0.878	0.673	2.568	3.272	3.977	1.409
20	0.000	0.129	0.225	0.193	0.322	0.129	3.096	1.253	0.795	2.035	3.250	4.125	2.089
21	0.000	0.193	0.322	0.258	0.096	0.129	2.645	1.258	0.640	1.675	2.450	3.406	1.731
22	0.000	0.129	0.322	0.290	0.161	0.096	2.774	1.155	0.452	1.875	2.666	3.550	1.675

Table H-4

MACHINE TOOL IV GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.500	0.083	0.333	0.000	0.083	2.083	1.255	0.885	1.000	1.500	3.000	2.000
13	0.000	0.500	0.333	0.083	0.083	0.000	1.750	0.924	0.590	1.000	1.500	2.250	1.250
14	0.000	0.000	0.000	0.666	0.333	0.000	3.333	0.471	0.134	2.875	3.250	3.750	0.875
15	0.000	0.000	0.083	0.750	0.166	0.000	3.083	0.493	0.568	2.722	3.055	3.388	0.666
16	0.000	0.000	0.083	0.166	0.333	0.416	4.083	0.953	0.003	3.500	4.250	4.900	1.400
17	0.000	0.250	0.250	0.250	0.166	0.083	2.583	1.255	0.508	1.500	2.500	3.500	1.999
18	0.000	0.000	0.333	0.250	0.250	0.166	3.250	1.089	0.516	2.250	3.166	4.166	1.916
19	0.000	0.000	0.000	0.666	0.250	0.083	3.416	0.640	0.708	2.875	3.250	3.833	0.958
20	0.000	0.000	0.083	0.666	0.250	0.000	3.166	0.552	-0.073	2.750	3.125	3.500	0.750
21	0.000	0.083	0.500	0.250	0.083	0.083	2.583	1.037	0.748	1.833	2.333	3.166	1.333
22	0.000	0.166	0.333	0.416	0.000	0.083	2.499	1.040	0.399	1.750	2.500	3.100	1.349

Table H-5

MACHINE SHOP II GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.636	0.272	0.090	0.000	0.000	1.454	0.655	0.357	0.892	1.285	1.916	1.023
13	0.000	0.545	0.363	0.090	0.000	0.000	1.545	0.655	0.204	0.958	1.416	2.062	1.104
14	0.000	0.000	0.090	0.636	0.272	0.000	3.181	0.574	0.656	2.750	3.142	3.583	0.833
15	0.000	0.090	0.000	0.181	0.454	0.272	3.818	1.113	0.274	3.375	4.000	4.583	1.208
16	0.000	0.000	0.181	0.181	0.363	0.272	3.727	1.052	0.036	2.875	3.875	4.583	1.708
17	0.000	0.090	0.181	0.363	0.272	0.090	3.090	1.083	0.505	2.375	3.125	3.916	1.541
18	0.000	0.090	0.090	0.363	0.363	0.090	3.272	1.052	-0.138	2.687	3.375	4.062	1.375
19	0.000	0.000	0.181	0.454	0.272	0.090	3.272	0.862	0.562	2.650	3.200	3.916	1.266
20	0.000	0.181	0.090	0.545	0.181	0.000	2.727	0.962	0.506	2.249	2.916	3.375	1.125
21	0.000	0.272	0.181	0.545	0.000	0.000	2.272	0.862	0.623	1.416	2.583	3.041	1.625
22	0.090	0.272	0.454	0.181	0.000	0.000	1.899	0.699	0.338	1.333	1.900	2.400	1.066

Table H-6

MECHANICAL DESIGN IV GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.363	0.363	0.272	0.000	0.000	1.909	0.792	0.594	1.187	1.875	2.583	1.395
13	0.000	0.363	0.545	0.090	0.000	0.000	1.727	0.616	0.559	1.187	1.750	2.208	1.020
14	0.000	0.090	0.454	0.272	0.090	0.090	2.636	1.067	0.313	1.850	2.400	3.250	1.400
15	0.000	0.090	0.090	0.454	0.272	0.090	3.181	1.028	0.157	2.650	3.200	3.916	1.266
16	0.000	0.090	0.000	0.363	0.363	0.181	3.545	1.075	-0.012	2.937	3.625	4.312	1.375
17	0.000	0.090	0.181	0.454	0.000	0.272	3.181	1.266	0.772	2.375	3.000	4.583	2.208
18	0.000	0.090	0.272	0.272	0.181	0.181	3.090	1.239	0.667	2.083	3.000	4.125	2.041
19	0.000	0.090	0.181	0.272	0.272	0.181	3.272	1.212	0.680	2.375	3.333	4.250	1.875
20	0.000	0.090	0.272	0.545	0.090	0.000	2.636	0.771	0.211	2.083	2.750	3.208	1.125
21	0.000	0.090	0.545	0.181	0.181	0.000	2.454	0.890	0.505	1.791	2.250	3.125	1.333
22	0.000	0.363	0.363	0.272	0.000	0.000	1.909	0.792	0.708	1.187	1.875	2.583	1.395

Table H-7

MECHANICAL DESIGN II GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.444	0.222	0.222	0.111	0.000	2.000	1.054	0.105	1.062	1.750	2.875	1.812
13	0.000	0.222	0.444	0.111	0.222	0.000	2.333	1.054	0.700	1.562	2.125	3.250	1.687
14	0.000	0.000	0.111	0.111	0.666	0.111	3.777	0.785	0.651	3.541	3.916	4.291	0.750
15	0.000	0.000	0.111	0.333	0.222	0.333	3.777	1.030	0.540	2.916	3.750	4.750	1.833
16	0.000	0.111	0.000	0.333	0.444	0.111	3.444	1.065	-0.337	2.916	3.625	4.187	1.270
17	0.000	0.444	0.111	0.333	0.111	0.000	2.111	1.099	0.111	1.062	1.999	3.083	2.020
18	0.000	0.000	0.111	0.222	0.555	0.111	3.666	0.816	0.660	3.125	3.800	4.250	1.125
19	0.000	0.111	0.222	0.222	0.333	0.111	3.111	1.196	0.806	2.125	3.250	4.083	1.958
20	0.000	0.111	0.555	0.111	0.111	0.111	2.555	1.165	0.965	1.750	2.200	3.250	1.499
21	0.000	0.555	0.000	0.333	0.000	0.111	2.111	1.369	-0.136	0.950	1.400	3.083	2.133
22	0.000	0.333	0.333	0.222	0.000	0.111	2.222	1.227	0.724	1.250	2.000	2.875	1.625

Table H-8

INDUSTRIAL DRAFTING II GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.125	0.875	0.000	0.000	0.000	1.875	0.330	-0.267	1.642	1.928	2.214	0.571
13	0.000	0.125	0.500	0.375	0.000	0.000	2.250	0.661	0.000	1.750	2.250	2.833	1.083
14	0.000	0.000	0.125	0.500	0.250	0.125	3.375	0.856	0.515	2.750	3.250	4.000	1.250
15	0.000	0.000	0.250	0.375	0.375	0.000	3.125	0.780	0.283	2.500	3.166	3.833	1.333
16	0.000	0.125	0.250	0.250	0.375	0.000	2.875	1.053	-0.671	2.000	3.000	3.833	1.833
17	0.000	0.250	0.375	0.375	0.000	0.000	2.125	0.780	0.566	1.500	2.166	2.833	1.333
18	0.000	0.000	0.250	0.500	0.125	0.125	3.125	0.927	0.619	2.500	3.000	3.500	1.000
19	0.000	0.000	0.375	0.250	0.375	0.000	3.000	0.866	0.867	2.166	3.000	3.833	1.666
20	0.000	0.000	0.375	0.375	0.250	0.000	2.875	0.780	0.452	2.166	2.833	3.500	1.333
21	0.000	0.375	0.375	0.125	0.125	0.000	2.000	1.000	0.707	1.166	1.833	2.500	1.333
22	0.000	0.000	0.625	0.375	0.000	0.000	2.375	0.484	0.273	1.900	2.300	2.833	0.933

Table H-9

AUTO BODY IV GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.333	0.416	0.166	0.083	0.000	2.000	0.912	0.177	1.250	1.900	2.500	1.250
13	0.000	0.416	0.250	0.250	0.083	0.000	2.000	1.000	0.141	1.100	1.833	2.833	1.733
14	0.000	0.000	0.000	0.750	0.250	0.000	3.250	0.433	0.023	2.833	3.166	3.500	0.666
15	0.000	0.000	0.083	0.250	0.500	0.166	3.750	0.829	0.525	3.166	3.833	4.333	1.166
16	0.000	0.083	0.083	0.083	0.500	0.250	3.750	1.163	0.252	3.500	4.000	4.500	1.000
17	0.000	0.333	0.250	0.166	0.166	0.083	2.416	1.320	0.621	1.250	2.166	3.500	2.250
18	0.000	0.083	0.333	0.333	0.166	0.083	2.833	1.067	0.664	2.000	2.750	3.500	1.500
19	0.000	0.000	0.333	0.583	0.083	0.000	2.749	0.595	0.595	2.250	2.785	3.214	0.964
20	0.000	0.000	0.166	0.500	0.333	0.000	3.166	0.687	-0.265	2.666	3.166	3.750	1.083
21	0.000	0.333	0.333	0.250	0.083	0.000	2.083	0.953	0.902	1.250	2.000	2.833	1.583
22	0.000	0.333	0.333	0.333	0.000	0.000	2.000	0.816	0.620	1.250	2.000	2.750	1.500

Table H-10

ELECTRONICS TECHNOLOGY IV GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.000	0.333	0.416	0.166	0.083	0.000	2.000	0.912	0.484	1.250	1.900	2.500	1.250
13	0.000	0.291	0.291	0.375	0.041	0.000	2.166	0.897	0.654	1.357	2.214	2.944	1.587
14	0.000	0.000	0.166	0.208	0.416	0.208	3.666	0.986	0.415	2.900	3.800	4.400	1.500
15	0.000	0.000	0.333	0.166	0.375	0.125	3.291	1.059	0.050	2.250	3.500	4.166	1.916
16	0.000	0.000	0.208	0.333	0.333	0.125	3.375	0.949	-0.324	2.625	3.375	4.125	1.500
17	0.000	0.291	0.416	0.166	0.083	0.041	2.166	1.067	0.561	1.357	2.000	2.750	1.392
18	0.000	0.125	0.541	0.125	0.125	0.083	2.499	1.118	0.696	1.730	2.192	3.166	1.435
19	0.000	0.083	0.541	0.166	0.166	0.041	2.541	0.999	0.632	1.807	2.269	3.250	1.442
20	0.000	0.166	0.416	0.291	0.125	0.000	2.375	0.904	0.809	1.700	2.300	3.071	1.371
21	0.000	0.333	0.500	0.125	0.041	0.000	1.875	0.780	0.586	1.250	1.833	2.333	1.083
22	0.000	0.458	0.458	0.083	0.000	0.000	1.625	0.633	0.506	1.045	1.590	2.136	1.090

Table H-11

CONSERVATION IV GROUP ITEM ANALYSIS STRUCTURED/UNSTRUCTURED
LEARNING STYLE CONTINUUM

Item	Omit	1	2	3	4	5	Mean	Stan. Dev.	P-Cor	Q_1	Q_2	Q_3	I.Q.R.
12	0.018	0.471	0.301	0.188	0.000	0.018	1.769	0.890	0.369	1.020	1.562	2.375	1.355
13	0.000	0.339	0.320	0.264	0.018	0.056	2.132	1.082	0.366	1.236	2.000	2.839	1.603
14	0.000	0.000	0.169	0.509	0.301	0.018	3.169	0.719	0.211	2.657	3.148	3.734	1.076
15	0.000	0.037	0.207	0.396	0.264	0.094	3.169	0.985	0.139	2.511	3.142	3.910	1.398
16	0.000	0.000	0.188	0.150	0.603	0.056	3.528	0.860	-0.044	2.906	3.765	4.179	1.273
17	0.000	0.245	0.301	0.245	0.150	0.056	2.471	1.175	0.669	1.515	2.343	3.326	1.811
18	0.000	0.132	0.207	0.169	0.415	0.075	3.094	1.201	0.732	2.068	3.444	4.079	2.011
19	0.000	0.132	0.132	0.358	0.301	0.075	3.056	1.122	0.615	2.392	3.157	3.921	1.529
20	0.000	0.132	0.320	0.377	0.150	0.018	2.603	0.958	0.592	1.867	2.625	3.287	1.419
21	0.000	0.264	0.264	0.377	0.094	0.000	2.301	0.963	0.520	1.446	2.392	3.087	1.641
22	0.000	0.396	0.320	0.169	0.094	0.018	2.018	1.054	0.671	1.130	1.823	2.694	1.563